# Editorial

WHAT limits must be set today to an all-round education designed to make young people aware of what goes on around them?

This is a question which is posing itself ever more keenly in the minds of educationists.

It becomes all the more important when we remember how greatly scientific matters are infiltrating our everyday lives.

The field of electronics is a good example of this. In nearly every walk of life, sooner or later we come up against a process or a machine either completely electronic or electronically controlled.

Just as an elementary acquaintance with simple mechanics is necessary to a home carpenter, so some knowledge of electronics is going to help us find our way about the world of the immediate future, and might even save our lives.

And the lad who runs round with his atom gun, and rides the heavens in his symbolic space-ship—he is playing with toys which stand for things which will profoundly influence his life. They cannot remain a game for ever.

How can he form wise judgments and personal decisions when he becomes a man unless his thinking includes a balanced picture of the universe, as familiar to him from early years as are the more tangible objects with which he makes everyday contact?

How much less bias and superstition, how fewer emotional conflicts will he encounter if his grasp of these tremendous fundamentals is clear? There can be no greater service than to widen a young person's mind in its thinking habits and its search for truth—no greater danger than to risk confusion and inevitable maladjustment to life through restricted and poorly informed education.

There is so much to know, and so little time to learn. Our young people have no alternative but to come to grips with more knowledge as soon as they are able. For the fully qualified specialist, post-graduate study seems the only solution.

One of the penalties we must pay for living in a modern society is to subject ourselves to the self-discipline required to understand it and to mould it to our heart's desire. There is no other path but chaos or disintegration.

Congratulations to Mr. J. B. Corbin, NSW President of the WIA on his recent award of the MBE. A well-deserved recognition of personal service and that of his fellow amateurs in a national emergency.

John Moyle

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RADIO TELEVISION & HOBBIES

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**OUR COVER PICTURE**

Made by the Armstrong-Whitworth company in England, this guided missile was on display for the first time during recent Navy Day celebrations at the Royal Navy Barracks and Dockyard in Chatham, England. Naval ratings are seen handling the missile, similar to those now forming an important part of naval armament.

# The Palec

## VACUUM TUBE

# VOLT-OHMMETER

**MODEL TV-M**

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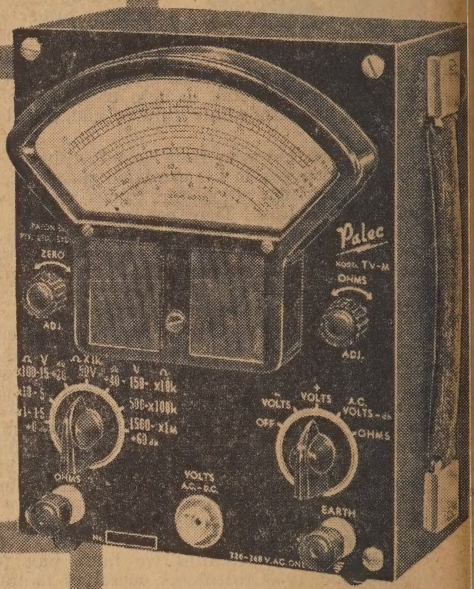


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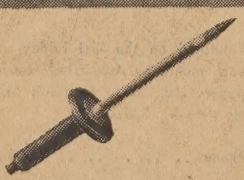

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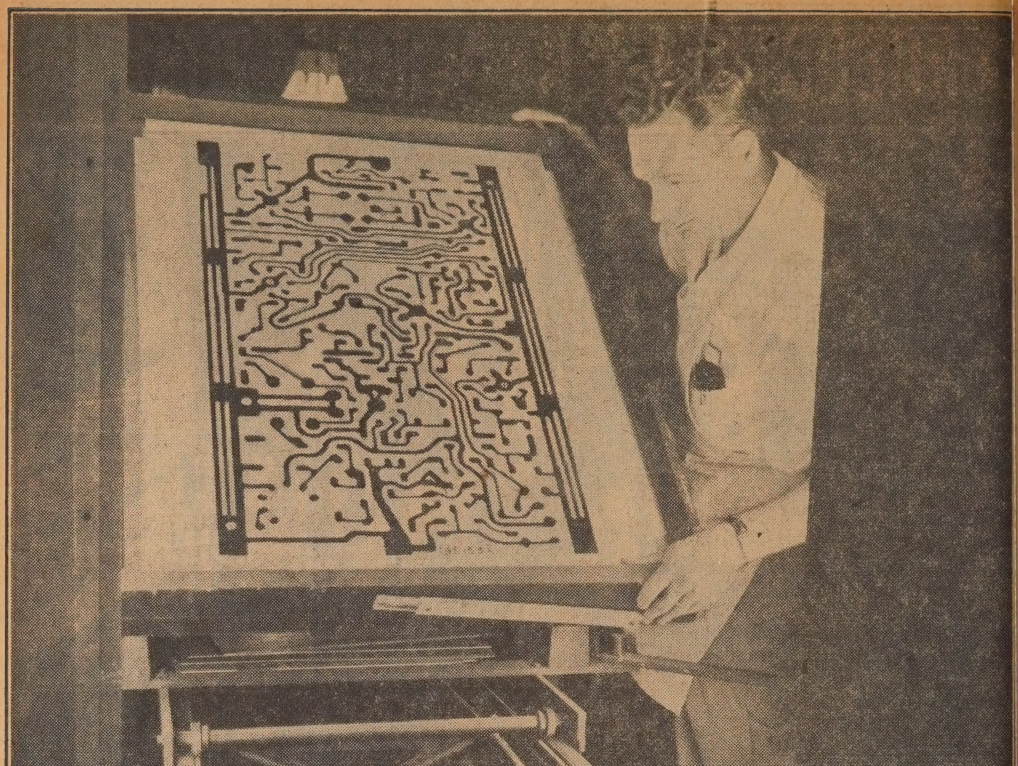
# PRODUCTION LINE WIRING FOR TV

AUTOMATIC TV PRODUCTION LINE. This 30ft-long battery of machines automatically assembles approximately one half of Admiral's new vertical chassis for television receivers. Employee is holding bottom side of printed circuit section showing soldered connections (left) and in right hand shows top side with parts. Electrical components, such as resistors and wire jumpers are automatically fed to "Robot 1", as the exclusive production line has been named. Printed circuit chassis results in more uniform production, trouble-free soldering and lower productions costs. (Story next page.)



MASTER DRAWING OF TV PRINTED CIRCUIT. First step in producing a printed circuit for a television receiver is photographing a large drawing of the circuit layout with a huge camera that reduces it to a sharp actual size negative. The negative is then placed in a printer, as in any photographic process, and the "picture" is printed on an aluminated plastic sheet, one side of which is covered with thin copper foil.

# PRINTED CIRCUITS FOR TV SETS

**Labor costs are a big factor in the high price of TV receivers which, by their comparatively complicated nature, call for the wiring of many components and assemblies. By applying the printed circuit technique, first developed during the last war, much of the intricate wiring can be made a completely automatic process, ideal for mass production runs. Whether it will be possible to use it in Australia is problematical but it is playing a big part in the huge factories overseas.**

THE American Admiral Corporation has recently developed and now uses a series of new and revolutionary high speed robot machines. These machines automatically assemble in a matter of seconds "printed circuits" for modern TV sets that are equivalent to approximately one-half of a television chassis.

Highly mechanised television production lines eventually will have the same effect on the electronics industry that Henry Ford's moving chassis assembly line methods had on the giant automotive industry more than 40 years ago.

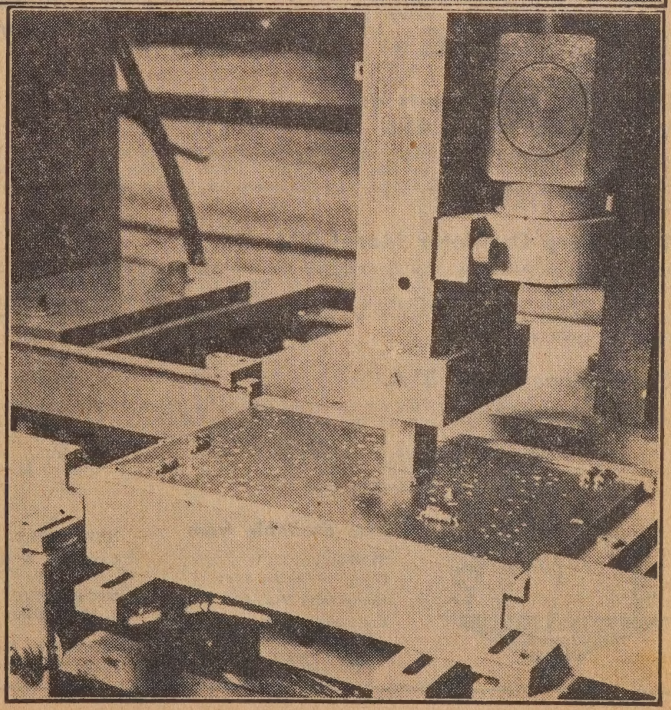
The printed robot chassis assembled by automation has made possible for the first time a TV set utilising a giant aluminised 21in 90-degree tube with a 270 square inch picture and a full 18-tube vertical chassis, The recently developed tube fits into a compact space-saver cabinet that is 3in shorter and 5in lower than before.

The company has built and installed a 30ft long battery of complex machines into which electrical components such as resistors and wire jumpers are automatically fed and from which is delivered a completely assembled printed circuit board in a few seconds. Eight tubes are used in this section.

Thousands of man hours were devoted to research work on this development. To put the machinery into production required an investment of hundreds of thousands of dollars in tools and equipment. It also required the redesigning of components so they would fit into the feeding chutes.

In operation, the robot machines

Above:
RETOUCHING PRINTED CIRCUIT BOARDS. Picture shows an employee inspecting printed circuits for television, produced 12 on a sheet, and retouching wherever needed. The large boards are later cut and trimmed and punched with holes to receive the wires and various electrical components to be mounted on them.



Right:
INSERTING WIRE JUMPERS. This close-up shows the head of one of the automatic production machines inserting wire jumper that connects the circuits on a printed circuit board. The light at the lower left turns red automatically whenever a component fails to feed properly and the entire battery of machines is stopped.

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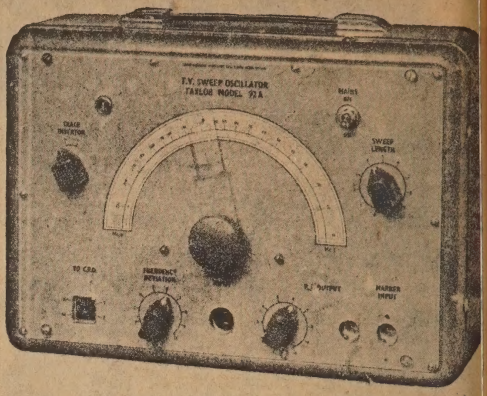


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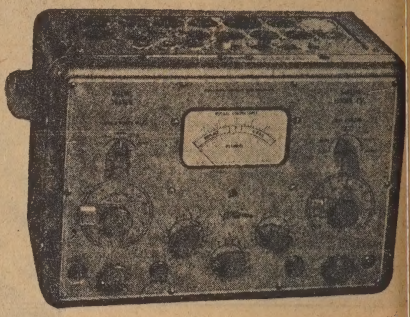

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### Oscilloscope Model 31A.

A particularly robust instrument designed primarily to meet the requirements of Television and Radio Service work, but also very suitable for use as a general purpose instrument. Tube—Cossor 88J (Blue), 4in dia., electrostatic deflection, E.H.T. 1200v. Cathode to final anode. Input sensitivity 12.5v R.M.S. per inch; input resistance approx. 5 Megohms. Y Amplifier Frequency response 10 c/s to over 6 Mc/s within $+\frac{1}{2}$—3db. **Price:** £97/5/6 (plus sales tax).

Oscilloscope Model 31A.

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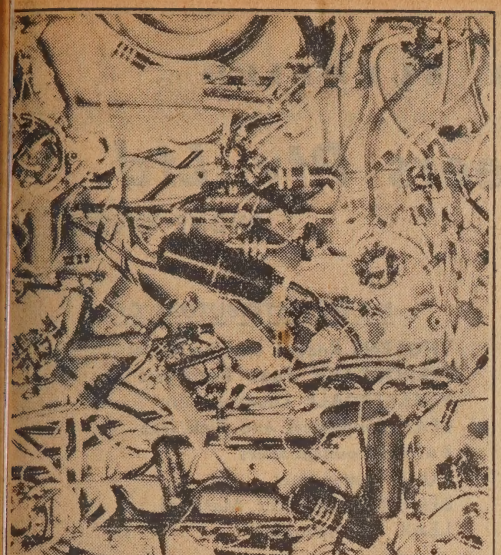
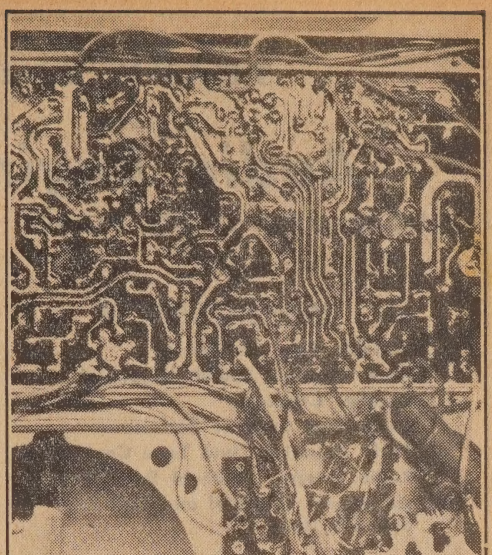


BEFORE. Old style TV wiring. This is the way the underside of a television chassis used to look with its jumble of wiring. It is a far cry from the modern method incorporating printed circuits and an automatic production line.



AND AFTER. Photo shows close-up of printed circuit which embodies approximately 50 per cent of the wiring in the new vertical chassis television receiver.
Note how simple it looks without the usual mess of "spaghetti".

tilise printed circuit boards which re photo-etched and stamped. Stacked boards are automatically noved from machine to machine for speedy trip down the 30ft line.

Fifty assorted resistors and wire umpers are automatically inserted n the board, some singly, some two t a time and some three at a time. Before inserting the resistors, the obot machines trim the wire leads o size, then crimp them precisely o contact the copper circuit pattern.

The new equipment is so constructed that whenever any part fails o feed from the chute a red light goes on at that machine. The entire ine is automatically halted until adustments are made and the components again feed smoothly.

"Robot I," as the equipment has been dubbed, has only scratched the urface. Two other machines—one approximately 100ft long—are under onstruction and will be in use early n 1955.

There's practically no limit to what automation can accomplish in he television industry. Eventually he machines will be able to insert uch complex items as tube sockets nd tubes.

The advantages of using a printed obot chassis include: more uniform roduction, trouble-free soldering, greater resistance to extremes of emperature and humidity, more lexibility of engineering and lower roduction costs.

---

A MICROSCOPE that spots clusters of radioactive atoms in metal r living tissue has been created in he USA. The mircoscope speeds p a slow process now involving hotograpic plates. A sample of the naterial to be examined is placed he USA. The microscope speeds or radioactive atoms that emit beta ays.

Dip soldering. After the 69 resistors, condensers, coils, tube sockets and other components are mounted on printed circuit board, the underside is dipped in molten lead solder for a few seconds to connect the crimped ends of the leads to the printed circuit.

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# NEW EAR HEARS HEART FAULTS

**Some of the heart's faint sounds, which neither the human ear nor a physician's stethoscope can hear, now can be seen with a new device developed co-operatively by the Medical College of South Carolina and General Motors Research Laboratories Division. These low frequency vibrations, below the range of human hearing, are detected by an Electro Stethograph. Medically they are reported to be of "potential clinical significance".**

THE Surfagage, incidentally, is used in machine shops, manufacturing and assembly plants to measure roughness of such highly machined auto parts as gear teeth, clutch facings, crankshafts, bearings and cylinder bores.

The stethograph was developed by mating part of a stethoscope, the medical profession's traditional listening device for heart and chest sounds, with the supersensitive pickup of the surfagage.

In essence, this combination gives physicians a high fidelity record of the heart's sounds and vibrations. Its sensitivity can be compared with that of a seismograph, which records earth tremors so faint they are unnoticed by human beings.

Drs. Groom and John A. Boone, professor of medicine at the Medical College of South Carolina, now can see the heart's inaudible sound either with an oscilloscope, which resembles a miniature TV screen, or a direct writing device that records wavy or zigzag lines with pen and ink.

## NEW CLUES

With the engineering job of detecting these new "sounds" accomplished, medical researchers believe the low frequency tracings or patterns will offer new clues to the heart's behavior.

They may indicate whether a heart functions normally or is affected by some disease or defect. The problem now is to accumulate clinical data to compare or contrast with known patterns of normal heart action.

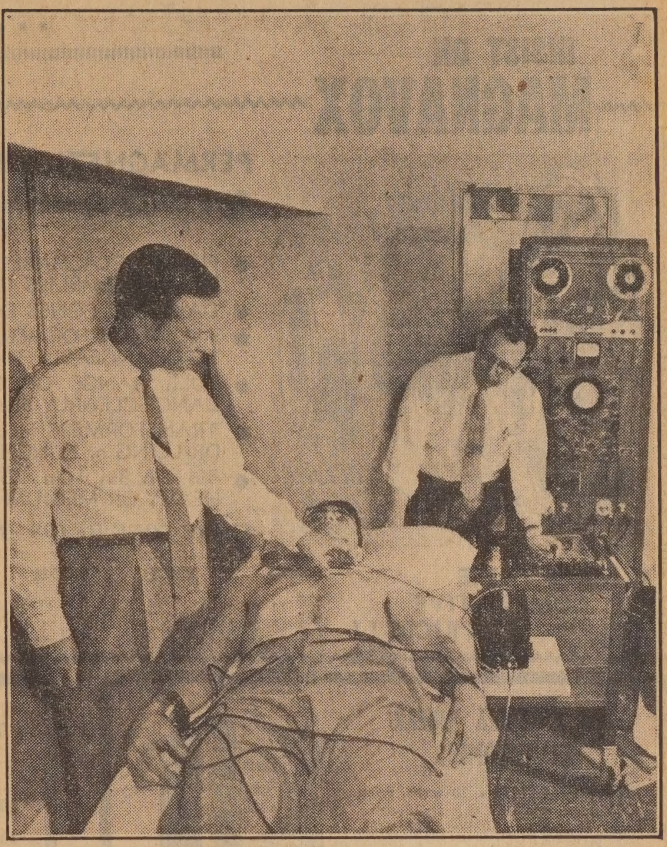
A patient undergoing examination merely lies on a foam rubber mattress, which absorbs any interference vibrations. The stethograph pickup, approximately the diameter of a silver dollar with a small arm attached, is placed on the patient's chest and the heart vibrations are observed or recorded.

The principle by which the stethograph and surfagage operate is similar.

## SURFAGAGE

The surfagage detects scratches as small as one-millionth of an inch (one microinch) on surfaces of highly-machined automotive parts. Its pickup consists of a tiny diamond stylus linked with what engineers call a high sensitivity transducer that transforms motion into electrical signals.

When the stylus is moved over unseen "peaks and valleys" on a machined metal surface, its microscopic up-and-down motion is transformed into electrical signals.



Dr. Dale Groom of the Medical College of South Carolina (left) adjusts the sensitive pickup of the Electro Stethograph over the heart of a patient, while Joseph B. Bidwell of General Motors research laboratories operates a direct writing device that traces the heart's inaudible sounds. The Stethograph enables physicians to see the sounds they cannot hear with their stethoscopes.

## DIAPHRAGM

The diaphragm head af a stethoscope is attached to the surfagage pickup. The diaphragm is the part of the stethoscope that rests on a person's chest when a doctor listens to his heartbeat.

The human ear can hear sounds ranging anywhere from 30 to 15,000 cycles per second. Its efficiency, however, is relatively poor in the lower part of the range.

The stethograph's hearing range is as low as one cycle per second. Vibrations of that order are produced by the heart's pumping action as imparted to the chest wall.

In a recent report Drs. Groom and Boone said these inaudible sounds represent the greater portion of the heart's vibrational energy, greater than the portion a physician ordinarily hears by ear through his stethoscope.

The doctors already have found the electro stethograph pickup so selective that its "hearing" is localised. For instance, as the pickup is shifted to various zones over a patient's heart, remarkable differences appear in the recorded waves.

It thus may be possible to localise certain waves or vibrations to particular areas of the heart.

The doctors visualise this new device as a supplement to other instruments for charting heart action —the electrocardiograph and the phonocardiograph.

# THE WARBURTON FRANKI PAGE

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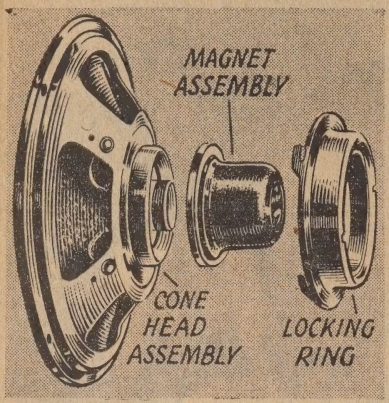


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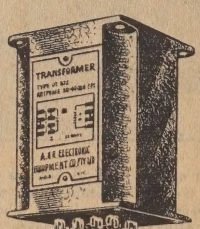


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# British firm shows TV in 3-D

**Demonstrations that showed how the technique of television can be applied to industrial production were given recently in Zurich by a UK firm. A feature of the demonstrations held in the Kongresshaus, were 3-dimensional and color television. The latter was on a closed circuit and was intended for industrial and not entertainment purposes. The colour image was displayed on an all-electronic 21in. (53.3cm.) receiver, and the prototype colour camera was of a new design, operating on 625 lines.**

THE 3-D system was made up of two industrial television cameras mounted side by side and connected to a special receiver consisting of two standard monitors with an adaptor. Overall size of the 3-D camera unit was 12in x 5½in x 10½in (30.4 x 13.9 x 26.6 cm).

At the 1954 Radio Show in London, the equipment was shown as a stereoscopic television system. At Zurich, however, it was shown quite openly to stress the fact that if two camera and monitor units and an adaptor are purchased, instead of a single camera, a 3-D system can be easily set up.

## THE ADAPTOR

The adaptor consists of a box with a semi-silvered mirror in which two monitors are positioned at right angles. The pictures from these two monitors are super-imposed by the semi-silvered mirror and viewed through an opening in the box. In front of each monitor is a polaroid filter, so that each eye of the viewer, who wears corresponding polaroid spectacles, sees only the picture intended for it. There are no filters at the camera end.

The 3-D demonstration was primarily intended to interest people who require remote handling facilities, as, for instance, in the handling of radio-active material.

Demonstrations of industrial television included its application:

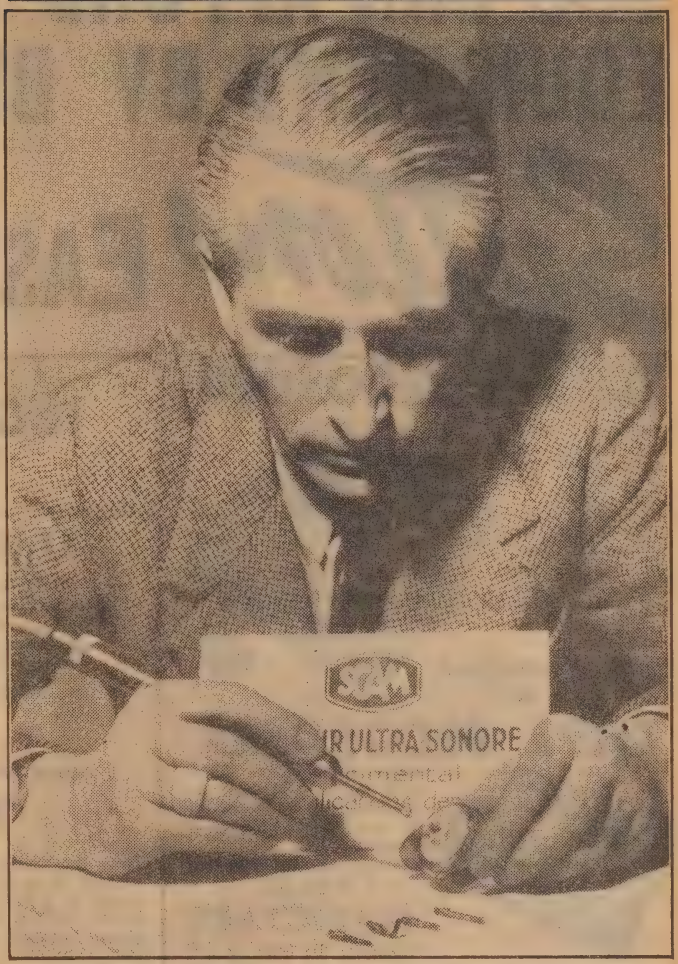
## VARIOUS USES

To microscopy, where it eliminates eye strain and allows a great number of people to watch at one time; as an aid to the visual transmission of ducuments from one central point to several different viewing points; as a medical aid to enable surgical operations to be watched by an unlimited audience; to the viewing of inaccessible meters or water gauges and telemetering; to vocational training (demonstrated by the assembling of a watch); and to the automobile industry in the road-testing of prototype vehicles.

A range of normal studio equipment, including the image orthicon camera chain, together with their accompanying accessories, was also on view.

After a lunch at the Kongresshaus a party of visitors were taken to the middle of the Lake of Zurich for a demonstration of underwater television. In addition to seeing the bottom of the lake for the first time in history, the party also saw on a television screen, a variety of marine life moving in the clear waters of the lake. The camera was of a type now being used by the British Navy.

# ULTRA-SONIC DENTISTS' DRILL




Highlight of a recent exhibition of dental equipment in Paris, was this prototype ultra-sonic drill, shown by Mr. Malençon. It allows teeth to be drilled by means of ultra-sonic vibrations. This prototype includes an ultra-sonic transmitter of 30Kc, linked by a tiny wire to a large pencil-like apparatus which holds the small piece of apparatus which can be interchanged to the shape of the cavity being drilled. A very fine abrasive is placed between the apparatus and the tooth.

# SOLAR HEATING SYSTEM

According to the American Society of Heating and Ventilating Engineers man will have to depend on sunlight for most of his fuel in the next 160 years. It is estimated that existing coal and oil supplies will be consumed by this time.

It is suggested that solar energy can be obtained during all days on the earth's surface, including cloudy days. Solar heat gathering systems are affected by the earth's position relative to the sun, solar constants, and depletion of radiation by the atmosphere.

Experts have worked out details for a model house in Nebraska, where winters are relatively severe. They determined that a house designed for a heat load of 62,000 BTU per hour can be heated during variable winters by a system equipped with a 700 square-foot solar-energy collector.

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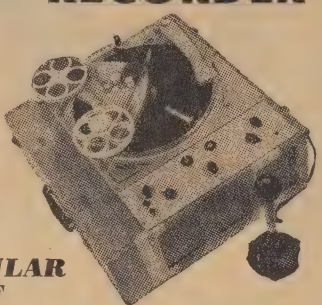
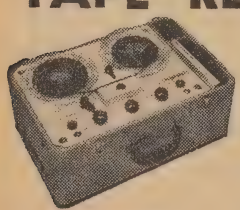


## ALL POPULAR MAKES OF TAPE RECORDERS



Suttons invite you to call at their Recording Division any day to try out or discuss any of the leading makes of machines.

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records for two hours on dual track. The second illustration shows another popular make—

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# MODERN SCIENTIFIC MYSTERIES

**Vortices are intriguing things, whether you study them in a jug of water on the kitchen table or in the bath, as the water runs down the plug-hole. They can be adapted for practical jokes and are one of the worries of an aircraft designer.**

by Prof. A. M. Low

HERE is an intriguing experiment which requires very little apparatus and no skill. You need a large glass jug of water as tall as possible, and a cup of milk.

Leave the jug of water to stand for about 12 minutes; now dip your finger in the milk and from a height of about 18in allow one drop to fall on to the water in the jug.

The milk drop will press itself beneath the surface of the water and set into operation a beautiful vortex ring, which will slowly curl down into the jug until, after a moment or two, local vortices break it off. The resulting pattern will excite the admiration of all.

## EXCITING VORTICES

Vortices are very exciting. It is these little "pieces" of air which help or retard an aeroplane and which have often been produced by gunfire to disperse rain clouds.

Lord Brabazon, who held the first pilot's licence in England, and who once tied a pig to an aeroplane in order to confute a popular saying, tells me that as a young man he fixed a small box with a hole in one side to a canvas bag under a piano.

Anyone coming into the room could be startled by an apparently invisible feather brush slapping them in the face. It was, of course, a vortex ring from the box which pointed toward the door and which had received a surreptitious kick at the right moment.

If you want to be scientific it is said that you can arrange two vortex rings to meet in the middle of a brightly lit beam and if in one box there is hydrogen and in the other nascent chlorine the rings when they meet produce a brilliant flash from, it seems, absolutely nowhere at all. A nascent mixture of the gases from a single box is generally more successful.

## THE TIME FACTOR

It is time that makes the difference between hard steel and soft air or water. Water can be very hard at high speeds. Try diving on to water and falling flat! There is a jet of water in a public garden on the continent and you cannot push your walking stick into it because its pressure is high and it is travelling fast.

Next time you dream, think of this case of time. You dreamed last night that you were shooting a lion. You bought your gun, went your journey, were frightened, and as your gun fired you woke up to find that the bang was someone tapping on your door with a cup of tea.

In other words, that tap on the door synchronised with the bang of your gun.

Two things might be true; first of all you must have dreamed the whole of that long dream in that tiny period between the bang on the door and your waking. What is more wonderful is that for the two bangs to have coincided you must have constructed the whole of that story about the lion backward in your brain. Time *is* queer!

Have you ever noticed the direction in which the water runs down your bath plug hole as the stream begins to form its vortex? A most learned discussion has taken place on this subject.

Some people say that the direction of the whirl was decided by the movement of the earth on its axis. The point is open to debate, but if this theory were true surely all the water in Australia would twirl one way and all the water in England the other?

This is not so and careful examination will show that the right or left-hand turn is decided by the manner in which the water leaves the bath. It is the turn of the pipe, or the grid, or the small

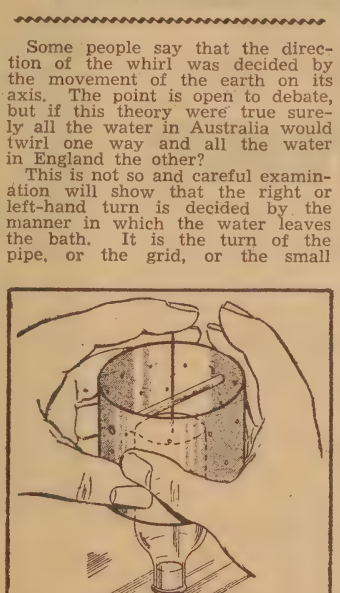

Fig. 1. Apparatus for demonstrating the "new force."

piece of solder left behind which gives the initial push to the flow.

There is another question: Should rifles be rifled right hand or left hand dependent upon where they are to be used, or should the sights be altered accordingly? The twist of the earth and the twist of the bullet work together to hold the projectile straight. This is an admirable subject for after-dinner discussion.

Here is an interesting little experiment. Take a glazier's diamond and rest it lightly upon any piece of glass. When the cutting angle is right, as if you were about to scratch a line to cut the glass, keep your hand steady and listen. You will hear birds chirruping, very very gently, but they do chirrup.

I put this down to the hand tremors and to the vibrations set up on the glass by the diamond beginning to penetrate.

Chirruping birds are, I think, very attractive, and it is always intriguing to think that in Trafalgar Square there are so many pigeons that there is very little room for them to perch.

Those which are not resting on the arms and shoulders of GI's being photographed sit all night watching the neon lights. The queer thing is that radiation from these neon lamps either appeals to the birds' sense of humor or they think it is the sun, for they chirrup most merrily to all hours of the morning. A most suitable place, in fact, for their night life!

## HOMING PIGEONS

I do not doubt they can find their way home quite easily, but I am not one of those who attribute the homing pigeon marvel to the mystery of radio. I rather fancy that in their brains they may have a kind of integrator.

Just as if you or I were blindfolded and turned round three times in one direction and four times in the other we might be able to finish up facing the way we started. Multiplied hundreds of thousands of times this skill could account for the homing instinct.

Have you heard of the new force which Air Chief Marshal Lord Dowding, of Battle of Britain fame, has been demonstrating? I do not say that I think it is a new force, but it is interesting to try the experiment.

You can make the apparatus in five minutes. Take a piece of ordinary notepaper approximately 7¾in long and about 2¾in wide. Cut it in half, leaving two pieces 3 5-8in by 2¾in.

## MAGIC CYLINDER

Now stick these together to make a paper cylinder 2¾in long. The reason for the cutting is so that there will be a join down both sides to make it even.

With a pin, pierce the cylinder all over from the inside so that the outside is slightly roughened; pin pricks ¾in or so apart are quite good enough. At one end of the cylinder approximately ¾in from the end pierce a hole on each side, the holes being opposite to each other. Across the inside glue an ordinary straw, the ends resting in the pierced holes, see Fig. 1.

Now you are ready. Put a needle

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own the axis of the cylinder rough the straw until it has penerated the straw by about ¼in and est the point upon the bottom of small medicine bottle about 2 or in high.

The cylinder should hang evenand there is, of course, hardly ny friction at all.

Avoiding all draughts, cup your ands round the side of the cylinder, not quite touching it and ou will find that the cylinder reolves slowly as if there were a ind blowing from the tips of your ingers.

Test this with different people, acing north, south, east, or west. Try it under all kinds of conditions nd you will have astonishing reults, which Lord Dowding thought night be a new effect, possibly not n accord with modern physical aws.

## SOME IDEAS

My own view is that convection urrents and static electrical effects an explain the phenomena. But I nope you will try it for it has been seen by some very eminent men n England and they are rather inclined to disagree as to the cause.

Growth is a wonderful thing. I do not agree with people who think that all children are charming. In my opinion nearly everything that they have comes from their parents. Perhaps one day they will be developed by pre-natal treatment.

Once I remarked in a book that the lilies of the field toiled very hard to grow. I am wrong, for it depends on the meaning of the word "toil".

But I have seen a convolvulus grow through a 6in concrete floor seeking for the sun, and I have looked at a small parcel of spring onions. which were left upon the floor in a dark cellar with one little window. Those simple plants turned their roots completely round so that their tendrils all pointed deliberately toward the one light spot.

It has been determined by experiment that onion roots will even grow together like people who want to embrace, and I am quite certain that our life and that of plants differs only by that great unknown factor of time.

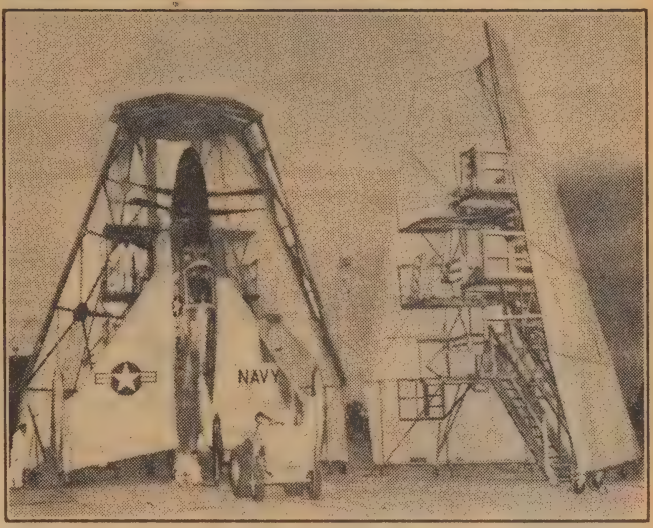
## SURFACE TENSION

It is fascinating to think that everything is held together by electric forces, and that our bodies are mostly space which we cannot see.

Then there is the queer fact that on the surface of liquids there is an added attraction which produces a kind of hard skin or form of "surface tension". Colloidal chemistry has shown us how particles of gold can be made so small as to stay suspended in water, but surface attraction is quite another story and if you take a perfectly dry needle and drop it very close to the surface of some water, keeping it absolutely level, it will usually float.

A still more striking example is shown by covering the surface of a bowl of water with the lycopodium powder which comes from a moss found in Russia. These particles are so small that their "tension value" is very high, and you can plunge your hand into the bowl of water through the skin of thin particles without it becoming wet in any way.

# NOVEL HANGAR FOR POGO PLANE




The U.S. Navy's vertical rising Pogo plane, made by Convair, is eased into its tepee-shaped hangar at a Naval Air Station. The hangar, built of wood and steel, opens like a giant clam shell to receive its on-tail occupant. The tepee's triple-deck work platform permits easy access to every part of the plane. The hangar is on wheels.

# NEW IDEAS FOR MODERN AIRCRAFT

**One of the most difficult tasks facing air forces today is interception of the high-speed high-altitude bomber, which must be prevented from reaching its target. The rapidly increasing speed of contemporary bombers has so reduced the time from receipt of warning to the actual interception and 'kill' that every second is vital.**

TIME-TO-HEIGHT of today's interceptor fighter is only a fraction of the best achieved during the last war, and it is fortunate that the turbojet engine does not require warming-up before take-off.

If full advantage is to be taken of these factors, as little time as possible must elapse from pressing the starter button to the fighter moving down the runway.

In Britain the Directorate of Operational requirements makes it mandatory that all fighter aircraft be equipped with self-contained starting systems, capable of bringing the engines to ground idling speed within ten seconds or less.

For smaller engines this requirement can be met by a cordite turbine starter and these have been in production for some time. For the large engines of today and even larger of tomorrow, the power required from the starter is so great that large cordite charges with special means of cooling the gases are required, so that their cost becomes prohibitive.

## STARTER UNIT IN PRODUCTION

One answer lies in using a special liquid "monofuel" for engine turbine starters as developed by Plessey. The company's fuel starter has passed bench and engine Ministry of Supply type tests, is flying in a new fighter aircraft and is going into production for the Royal Air Force and the Royal Australian Air Force. Manufacturing licences have been granted in the USA and Sweden.

Two sizes of the same basic starter have been developed, these being designed for engines requiring average starter powers of 70 hp and 150 hp. The peak power developed by the larger unit is of the order of 400 hp and this unit is now starting the largest engines built to date. The cost per start is 4/- for the present jet engines, and up to 7/- for the larger types under development. The fuel used—Iso-Propyl Nitrate—is safe, readily available and extremely economical.

## THE VITAL SPARK

The problem of providing an adequate "spark" for the latest jet engines has resulted in the development of a high energy igniter which produces a sufficiently hot, fat spark to vaporise and ignite liquid drops of paraffin or kerosene at very high altitudes and great speeds.

The high energy igniter produces a spark that dissipates 250 times as much energy as the conventional high tension plug, yet operates at only 2000 volts (instead of the 12,000 volts of a high tension plug).

The lady and the jewel—Linda Darnell is holding a star sapphire said to be the world's largest. It is the Black Star of Queensland and weighs 733 carats. Final polishing took three months.

# GEMS ARE LOVELY AND USEFUL

**For countless centuries man has used gems with which to adorn himself or his lady friends. The cutting of raw stones into glittering jewel pieces is one of the ancient crafts.**

by Calvin Walters

IN early historical times jewellery was supposed to confer some kind of magical power on the wearer and imbued divine protection.

In the Old Testament of the Bible, jewellery for adornment was often mentioned as for instance when the servant of Abraham met Rebecca at the well and gave her two bracelets of gold.

## SHAKESPEARE SAYS—

William Shakespeare mentioned that fact that "dumb jewels often in their silent kind, more than quick words, do move a woman's mind". How true, how true.

Many a man has found that out for himself. It is a most expensive method of moving a woman's mind, but very often the only way possible.

Expensive diamonds in a ring often clinch an engagement of marriage. Often they do not, and, while it is fairly easy to move a woman's mind to accept the ring, it is a difficult proposition to move her mind to give it back if the deal is calle off.

The value placed upon a ge depends on certain factors, the mo important of which is beauty color, brilliance, and lustre. Ne comes hardness on which depen its durability. Then we have rarit Fashion, of course, plays a larg part as also degree of perfectio and ease of portability.

A gem stone is a mineral, and all the minerals known to the chemi only about four pc can be include in the list of gemstones.

## POPULAR STONES

At the head of the list are, course, the diamond, ruby, emeral and sapphire. Any stone that ca supplant these would have to be wonderful stone indeed.

The diamond is about the onl stone in which color does not pla an important part in its popularity With rubies, emeralds, aquamarine and so on color is the importan characteristic, which is valued.

However, while the diamond i itself is a colorless stone, it ha the remarkable property, when pro perly cut, of not only reflecting light but of breaking it up into the natura spectrum of colors as seen in th rainbow.

Hardness in a precious stone i the resistance it offers to scratch ing or abrasion. Toughness is it resistance to breakage.

A scale of hardness has been de veloped for all materials including non-precious stones. This scale i known as Mohs' scale, after the Viennese scientist, Friedrich Mohs who devised it.

The diamond heads the list of this scale and is given a hardness o 10. All other minerals, gems and materials have lower numbers, and it follows that any mineral wil scratch any other mineral with the same or a smaller hardness num ber.

The sapphire and ruby are o hardness 9. The topaz is 8, quartz 7-8.

Right down at the bottom of the list of hardness we find gypsum 2 and talc 1.

An approximate test for hardness may be made in the following way Any material of hardness up to 2½ can be scratched with the finger-

At left is a perfect diamond, without a flaw. In the centre is a diamond with two strikes on it, one in the centre and a long prong-like flaw at the bottom. There are also two flaws in the diamond at the right.

nail, those of 3 with a penny, from 3 to 5½ with a piece of window glass, those to 6 with the blade of a knife, those to 6½ with a file.

## GEM STANDARDS

The usual standard of measurement for precious stones is the carat. This has nothing to do with the well-known vegetable, although judging by the price of this vegetable at the present time one could easily assume there was some connection.

However, the term carat does have something to do with a vegetable, for it is derived from the word, "carob", which is a small oriental bean.

One ounce is equal to 141½ carats. There are 2268 carats to the pound.

The carat is now practically universal in meaning. Most respectable countries recognise it also as equal to 200 milligrams or two-tenths of a gram.

The metric carat system is very convenient. Thus a stone of three-quarters of a carat is expressed as weighing .75 carats.

Diamonds are often weighed in points where 100 points equal one carat. Thus, one point equals one-hundredth of a carat or .01 carats. Ten points are .1 carats or one-tenth of a carat. So that a diamond can be classed as being a ten-pointer, a twenty-pointer and so on.

The usual measurement for pearls is the grain which is one-twentieth of a gram so that four pearl grains equal one carat.

One can arrive at a rough estimation of the weight of a diamond in metric carats by measuring the diameter of the cut stones.

## SIZE AND WEIGHT

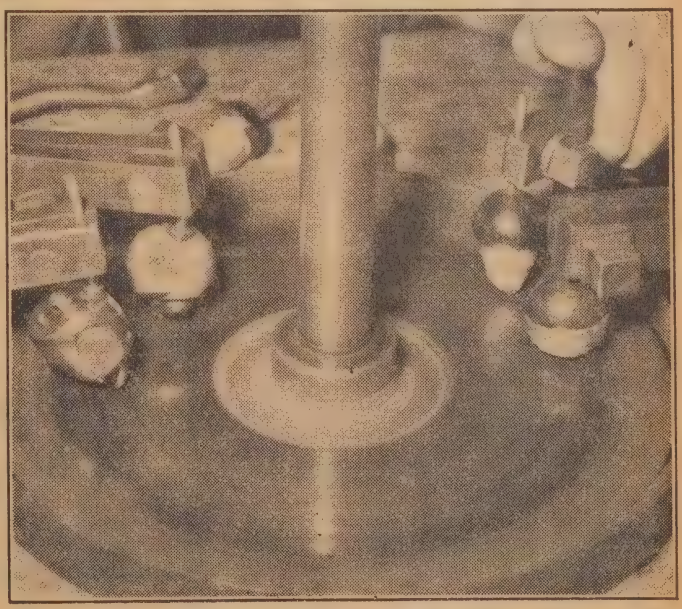
A stone slightly under one-eighth of an inch in diameter weighs about one-sixteenth of a carat.

One-eighth of an inch equals 1-8 carats. Five-thirty-seconds of an inch diameter equals ¼ carats. Three-sixteenths equals 3-8 carats. Seven-thirty-seconds equals ½ carat. A stone about ¼in in diameter is one carat. One about eleven-thirty-seconds weighs about two carats, about three-eights three carats, and seven-sixteenths equals four carats.

Of course, the exact weight depends on the depth of the stone but on an average the table is fairly approximate for rough purposes.

When a mineral compound is allowed to grow freely in any direction it assumes a certain form called a crystal. The shape of the crystal depends on the internal arrangement of the molecules so that the outside surfaces of the crystal are governed in shape by this internal arrangement of the molecules.

There are six main crystal systems but the technical details are very complicated and would require many pages of a highly technical nature to describe. It is sufficient to say that the true natural form of the gem stone consists of a crystal having many natural surfaces and faces which are very important in the cutting of the stone in order to bring out its characteristic features.



The stones are polished by a special steel disc which is porous. The pores hold a mixture of pure olive oil and hard gem dust. The disc revolves at 2,200 revolutions per minute. The two holders at the right have the gems embedded in solder.

PHILIPS

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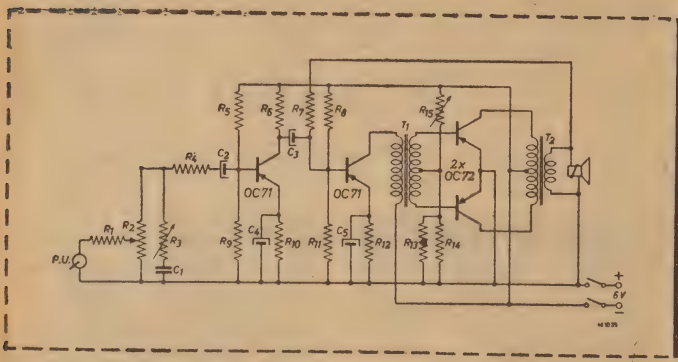


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An analogy can be made with a piece of common sandstone which is often seen in natural layers. This stone can only be split into slabs along the line of the intersection of each layer. It cannot be split across the layers without damaging the whole structure.

In a gem stone there may be many layers running in directions according to the molecular structure and sometimes experts may study a large stone for months before actual cutting into smaller stones takes place.

Craftsmen who cut stones into the required shapes are called lapidaries There is, however, a special significance attached to the work of diamond cutting which requires great skill. These craftsmen are highly trained and highly paid. To distinguish these aristocrats of the profession they are called diamond cutters, as distinct from lapidaries who treat only the softer and less valuable stones.

## STONE CUTTING

Cutting of gem stones is done on rapidly revolving copper discs, the edge of which is impregnated with diamond dust. Before this is done the diamond is closely examined under a magnifying glass in order to determine its structure. If the stone is a large one it may be necessary to break it into smaller stones.

In order to do this the line of cleavage must be determined and as mentioned above the stone may be studied for months by many experts before this line of cleavage is determined.

Having determined this line of cleavage, a notch is made in the stone and a blade inserted into the notch. This is given a blow with a mallet and if the determination was correct the stone will divide.

The usual procedure, however, is to saw the stone. For this purpose the line of cleavage is determined as before and a mark made on the stone with Indian ink. The stone is held in a special tool and cut with the copper or phosphor bronze disc as described above.

After cutting the stone must then be ground into shape with those many facets which bring out the brilliancy of the stone. Fifty-eight facets are usually ground on to the surface of the stone.

## IDEAL SHAPE

An ideal brilliant is usually made from the point of a natural crystal which has the true shape of a diamond crystal, namely, two four-sided pyramids base to base. A section drawn straight through the crystal from point to point would have the shape of the diamond on a playing card.

If such a crystal is sawn through, a little above the centre, we would have a stone with a point and four corners.

These corners are rounded off by mounting the stone on the end of a revolving spindle. Another stone mounted on the end of a long stick is held against it and the corners are gradually rounded off.

For grinding the facets the stone is now mounted on a tool called a "dop" and held against a rapidly-revolving porous iron wheel which has been impregnated with diamond dust. The position of the diamond being ground much be changed 58 times for a standard brilliant and the faces are microscopically examined every few seconds.

For maximum light reflection a well-cut diamond has 33 facets above and 25 facets below the round edge called the girdle. It has become standard practice to have about two-sevenths of the stone above the girdle, therefore the bulk of the stone is below the girdle.

If a diamond is too shallow or too deep it will fail to reflect light through the top and will be dead in the centre. These are usually termed "fish eyes".

At least half the weight of the diamond is lost in the cutting process but what is lost is many times made up in value by the polishing process which brings life into the stone.

## DIAMOND RACKET

Many people think there is a "racket" in diamonds and that the price is deliberately kept high by withholding stocks from the market. It is stated that if all the diamonds in stock were suddenly let loose on the market the price of a diamond would be equal to that of a piece of blue metal.

Now I hold no shares in diamond mines but such arguments as the above are manifestly absurd if for no other reason than that there is no substitute for the diamond in beauty, hardness, durability and usefulness among the minerals. One can hardly expect a piece of blue metal to be acceptable to a young lady for an engagement ring.

There is in addition an enormous amount of effort required in bringing the diamond from the mine to the shop window.

Diamonds occur in Africa in cylindrical natural pipes which consist of what is termed blue ground. Some of these pipes have been excavated to a depth of two-thirds of a mile vertically.

The ground is blasted clear of the sides and loaded on to trucks which carry it to the head of the mine. Here it is crushed, sieved and washed.

Of this about 99 pc is "dumped" while the remainder called the concentrates contains the diamonds.

These concentrates are fed on to a vibrating table coated with petroleum jelly to a quarter-inch depth. The concentrates are flushed over this table with water and while the unwanted material flows away, the diamonds stick to the jelly.

The tables are now scraped down, the petroleum jelly melted down and the diamonds recovered.

## SORTING

The stones are passed to the sorters who work under north light fluorescent lamps. The stones are picked out with tweezers and classified according to size, clarity, color, &c.

When the stones have been sorted into heaps, they are placed in small

(Continued on Page 119)

# PEARL SHELL HAS BIG VALUE

Pearl shell, once discarded, is now of great value, greater than that of the pearls which are found within them. This picture shows shells being packed at Darwin.

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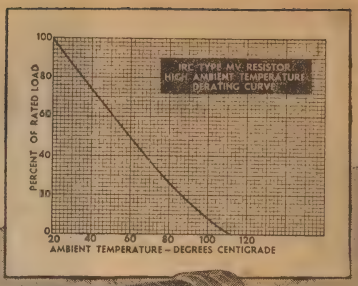





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**RATINGS** Indicated are maximum based on free air operation at 20°C. ambient. **DERATING** curve is available on application. **TEMPERATURE COEFFICIENT:** —.005%°C. for low resistance to —.07%°C. for high resistance values. **HUMIDITY:** General protective coatings of special varnish, baked individually at high temperature, provide protection against the effect of abnormal humidity.

**Contact your usual supplier for full details.**

| Type | Power Rating | Peak Voltage Rating | Minimum Available Resistance at 20% Tolerance | Maximum Available Resistance at 20% Tolerance | Dimensions | |
|---|---|---|---|---|---|---|
| | | | | | Ceramic Length | Resistor Body Diameter |
| MVF ..... | 2 watts | 5,000 | 2,500 ohms | 250 megohms | 1-3/4" | 5/16" |
| MVG ..... | 4 watts | 5,000 | 10,000 ohms | 700 megohms | 2" | 9/16" |
| MVJ ..... | 5 watts | 10,000 | 20,000 ohms | 1,500 megohms | 3" | 9/16" |
| MVP ..... | 10 watts | 15,000 | 50,000 ohms | 2,000 megohms | 4-1/2" | 3/4" |
| MVA ..... | 20 watts | 25,000 | 0.2 megohm | 4,000 megohms | 6-1/2" | 1-1/8" |
| MVO ..... | 30 watts | 50,000 | 0.4 megohm | 8,000 megohms | 10-1/2" | 1-1/8" |
| MVR ..... | 90 watts | 100,000 | 1.0 megohm | 20,000 megohms | 18-1/2" | 2" |

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# Technical Review

## STABILISED FILAMENT SUPPLY FOR AC-PORTABLES

**Battery valves in a universal portable receiver can burn out if they are subjected to filament voltages in excess of a certain permissible maximum, due to variation in the mains voltage. In the latest overseas portables this is prevented by using a novel means for stabilising filament supplies.**

THIS new method makes use of the non-linear characteristics of selenium rectifiers. When calculating the values of I and R of a selenium rectifier cell, it becomes evident that in the region from .4 to .7V, I increases and R decreases at a comparatively low rate. The cell, therefore, can be used for stabilising purposes in this region.

Figure 2 shows a practical arrangement of such a stabilising circuit. The rectifier Y rectifies the filament supply current and charges the capacitor C. The series filament chain F is connected across the supply with a series resistor R. The stabilising chain S is connected parallel to the filament chain.

If the filament voltage increases beyond the permissible figure, the resistance of the stabiliser drops, shunting the filament chain. The results in an increased voltage drop across R, thereby reducing the voltage across the filaments.

For best stabilisation the region between .4 and .7V is used. It follows that, for any given voltage V across the filament chain, the number of cells required will be 1.7 x V.

### PREMATURE FAILURE

Unavoidable differences in the heater current of individual valves often results in a premature failure of the weakest valve due to overheating.

In equipment, where uniformity of valve life is important, it is necessary to use valves with specially matched filaments for this reason. But if such matched valves are not available for replacement, an unmatched valve will only hasten the failure of the weakest filament in the chain.

The arrangement in Figure 3 provides for independent stabilisation for each valve by tapping the filament chain into the rectifier chain at the appropriate points. This makes matched filaments unnecessary, thereby reducing the cost of such equipment.

The selenium rectifiers used for this purpose have conventional appearance and their characteristic provides for a stabilised filament

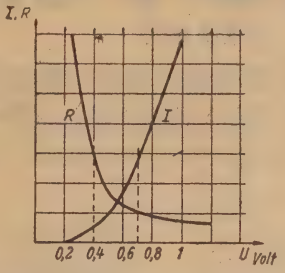


Figure 1: The current and resistance characteristics of a typical selenium rectifier element.

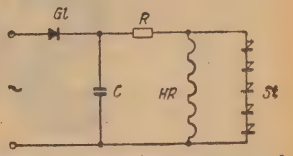


Figure 2: A simple arrangement of series rectifiers connected across a series filament network.

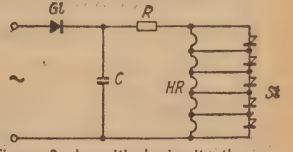


Figure 3: In critical circuits the rectifier and filament junctions may be interconnected as shown.

voltage of 1.35V at the usual current of .05V. Normally the current through the stabiliser does not exceed 25 pc of the filament current.

Since in the optimum region of regulation the cells are heat sensitive, it is advisable to keep them apart from heat producing components, such as power transformers and HT rectifiers to avoid upsetting the regulation.

Life expectancy and reliability of battery valves operated from mains supply are considerably improved by this method.

## BATTERY ADDITIVES USELESS

THINKING of buying some battery additive to "pep-up" that nearly defunct battery in the car? If so, scientists say, you would be better advised to save your money and put it toward a new battery, since all additives so far tested have proved to be quite useless.

Local battery manufacturers point out that such additives fall into two general classes; those using chemicals designed to dissolve the sulphate, which frequently renders the battery inoperative, and those which, following the line of brute force rather than science, consist simply of concentrated sulphuric acid.

The first approach at least has the advantage of having some scientific basis, even though, in practice, it doesn't quite work out as intended. The most common chemical used for this process is sodium sulphate, more commonly known as glauber salt. In theory, at least, this chemical will dissolve the lead sulphate which hampers the correct action of the battery.

In practice, the sulphate which causes trouble is that which has hardened and which has formed under the surface of the active material. Because of these facts neither the normal electrolyte nor the additive chemical can act effectively on the unwanted substance.

Putting it another way, the battery chemists point out that the additive will certainly dissolve sulphate, but only that sulphate which can also be dissolved by the electrolyte when the battery is properly charged. Therefore, the additive will not do anything which cannot be done just as effectively, and very much easier by well established methods.

This opinion is confirmed by a completely independent survey recently conducted in the USA by the Federal Trade Commission and the National Bureau of Standards. The bureau has been testing chemicals of this type for more than 30 years and reports that claims for them are quite misleading and the products "without merit".

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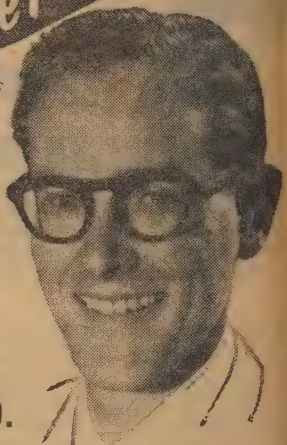

Mr. R. IREDALE
Recording Engineer
Festival Records Pty. Ltd.

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# A TRANSISTORIZED PORTABLE RECEIVER

**It may not be practicable yet to duplicate this receiver in Australia but it indicates what will come before very long. The circuit shown below includes some features already appearing in our articles on transistor sets. At the moment, cost would be high.**

ANOTHER commercially engineered, all-transistor receiver has made its appearance with the release of Raytheon's Model 8-TP-1 superheterodyne portable. The receiver uses 8 transistors and is powered by four of the 1.5 volt size "D" flashlight cells in series. Battery life is estimated at 500 hours for an operating cost of about 1/10 of a cent an hour. This is less than battery costs for standard tube, battery-operated portables.

The Model 8-TP-1 measures 2-5/8in thick, 6-3/16in high, and 9-3/16in wide at the bottom. It weighs 5lb with batteries. The circuit of the prototype design (Model FM-101) is shown in the schematic below.

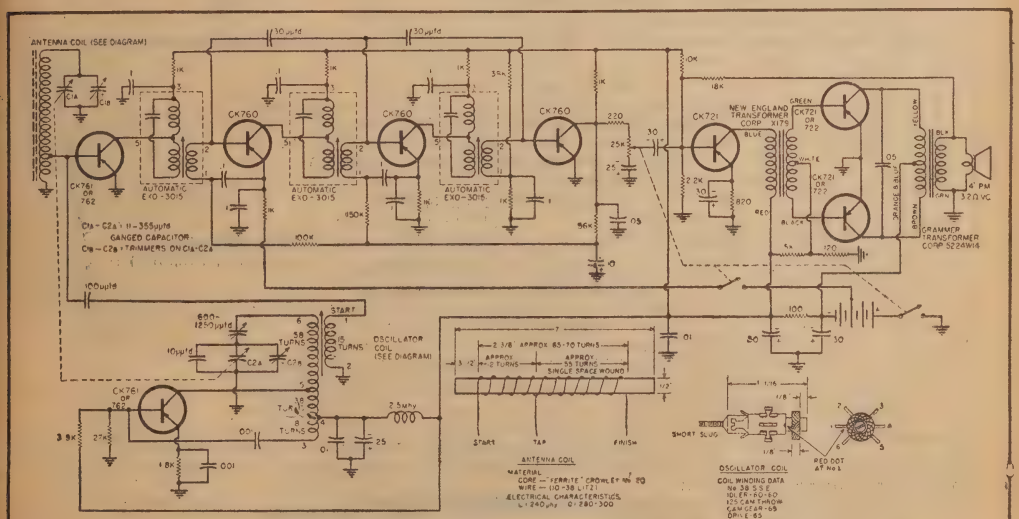
It uses two type CK760 high-frequency transistors as i.f. amplifiers; two type CK761 high-frequency units as mixer and oscillator; one CK760 or CK761 as the second detector; and three CK721 or CK722 transistors in the audio section of the set.

The performance of the prototype is very satisfactory and compares very favorably with conventional vacuum-tube portables. It covers the broadcast band from 530 kc. to 1620 kc.; has a sensitivity of 300-500 mv. per meter; a rated power output of 100 milliwatts with a maximum power output of 200 milliwatts; battery voltage of 6 volts; and a total current (no signal) of 7 mA. The total current at 100 milliwatts' output is 30 mA. According to the company, it is possible to obtain a power ouput of up to ½ watt by using two CK721 or CK722 transistors in class B push-pull operating at 6 volts, into a 250-ohm output transformer without exceeding the power-handling capabilities of these transistors.

The set is currently being marketed on a nationwide basis by Raytheon distribution outlets.

—Radio & Television News.

Below: Schematic of the new Raytheon prototype Model FM-101 portable receiver that uses eight transistors and four 1.5 volt batteries.




Automatic Manufacturing Company
65 Gouveneur St., Newark 4, N. J.

New England Transformer Company
Somerville, Massachusetts

Gramer Transformer Corporation
2734 N. Pulaski Rd., Chicago 31

**Since this circuit is based on a commercial design, many special components are involved. According to Raytheon, with the exception of the oscillator coil, all transformers are available from the companies named and the antenna coil can be easily built. For those who wish to duplicate this receiver, obtain an oscillator coil approximating the original and then experiment.**

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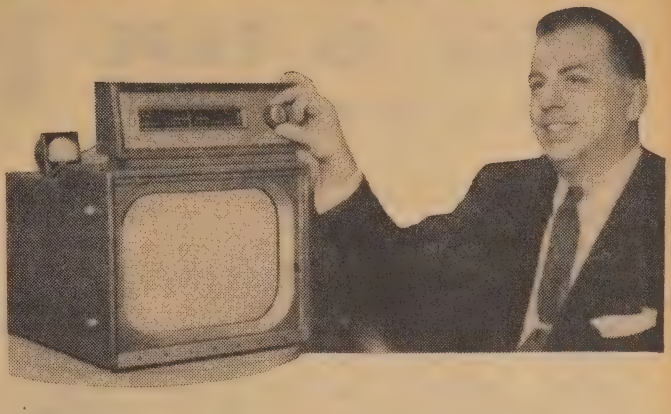
# LATEST APPLICATIONS FOR FERRITE ANTENNAS

**The ready availability of ferrite rods will doubtless open up new applications and two interesting ones are described in the May 1955 issue of Radio Electronics. One is an indoor TV antenna and the other, which will interest yachting and cruising enthusiasts, is a simple direction finder.**



The magnetic antenna in use with a television receiver. For best results it must be tuned to the frequency of each station or to a point near it which gives the clearest picture.

THE new TV antennas work by magnetic absorption. the magnetic signal inducing the RF voltage into the antenna coil winding. The indoor antenna that uses this fundamental principle is shown in the photograph.

The quantity of signal voltage induced is based upon the permeability and Q of the magnetic material as well as the Q of the tuned circuit.

To understand the operation of these new magnetic antennas, we must free our minds of the analysis applicable to metal antennas.

The term, "velocity of propagation", normally refers to the speed of transmission of TV signals through air or its lower speed in a metal type antenna.

The velocity of propagation for a magnetic antenna is very much slower. This means that a wavelength of magnetic material is much shorter than a wavelength using metal element material such as aluminium or brass.

## EFFECTIVE WAVELENGTH

Since the travel of TV signals through magnetic materials is much slower, a TV wavelength is compressed to fit the speed of the medium through which it travels.

Therefore, while a quarter-wavelength of metal rod at 200 megacycles would be in the neighborhood of 14 inches, its equivalent in magnetic material might be less than five inches.

The term, "effective permeability", is the ratio of the inductance of a coil with a magnetic core to the inductance of a coil with an air core.

Obviously, if the core used in place of air offers an easier path (lower reluctance) than the air medium, the material has a greater permeability.

As you can see from the photo, which shows the components of one of the first devices developed using this principle, the core is of magnetic material and will accept a greater number of magnetic lines and induce a greater voltage into the coil than if the coil had a straight air core and was tuned for resonance.

The engineering term referring to permeability is "mu". It is, therefore, said that a circuit using this type of magnetic material represents a high-mu circuit.

In magnetic antennas the higher the permeability of the material, the greater will be the signal pickup.

In a rod type antenna, the primary function of collecting the signal energy is performed by currents induced into the metal elements by the electrostatic field. As rod type antennas work from the electrostatic field, the term "permeability" is of little consequence.

The magnetic antenna receives its energy from the electromagnetic field. Therefore, it works in a field where the lower reluctance paths are important to efficiency. The higher the permeability of the material and the higher its Q, the greater will be its signal pick-up.

The Q of any magnetic material is determined by the reciprocal of its losses; the lower the losses, the higher the Q.

## WAVE PATH

The high frequencies do not travel on the surface of a magnetic material. They travel throughout the material, which makes the distribution of magnetic lines uniform throughout the core. Because of this uniform distribution of the flux lines, the losses in this specific new magnetic material designed for TV frequencies are very low.

In a metal antenna at TV frequencies, the signal currents are forced to the surface due to the resistance of the metal at these frequencies. This phenomenon is known as skin effect. These skin effect losses, in which the signals may be travelling on only a few ten-thousandths of the metal surface, result in resistive losses.

The Q of the magnetic material shown (see photo) may be in the order of 100 at TV frequencies. There are, of course, various other arrangements which improve the Q of this material by narrowing its bandwidth.

The overall efficiency of the magnetic material used for TV signal pickup will be determined by what is called the "mu-Q product", which means anything that you do to the core material to raise the permeability and the Q simultaneously will increase both the signal pickup and the overall efficiency.

The circuit Q possible in any arrangement using the magnetic material is usually higher, since inserting this material in a coil allows greater inductance with less wire.

Since wire has high resistance losses at TV frequencies, much less energy will be lost in a circuit using this magnetic material. This theory has been proven in the use of ferrite materials for broadcast antennas and other purposes.

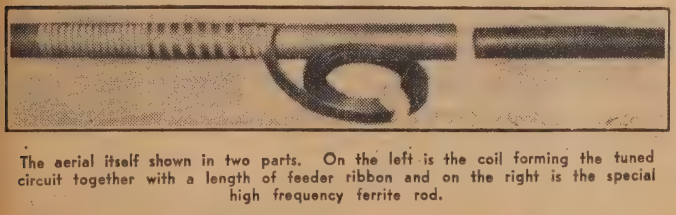
It should be understood that the magnetic material described in this article is not the standard ferrite material, which will not function at TV frequencies without high losses.

## AERIAL APERTURE

The aperture area of an antenna is that area which can be seen and cut by the magnetic lines in air. Fundamentally, the greater the aperture area, the greater the signal induced into the antenna.

The antenna shown in the design here will provide signal strength comparable to that of an indoor antenna adjusted for frequency. Of course, it is much more convenient to be able to tune this type of antenna than to push around ungainly rods.

These new magnetic materials have a minimum of ferrous content, and are not subject to corrosion. Surface corrosion will drop the signal level available from an antenna by



The aerial itself shown in two parts. On the left is the coil forming the tuned circuit together with a length of feeder ribbon and on the right is the special high frequency ferrite rod.

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A staff of chemists and physicists in the chemical and physical laboratories of Agfa at Leverkusen supervises the production. Each tape has been most thoroughly tested before it leaves the factory.

Swingy dance tunes and popular hit songs are reproduced by the Agfa Magneton Tape with such perfection that even a trained ear will hardly be able to distinguish between the original and the reproduction.

## TECHNICAL DATA on Agfa Magneton Tape FS:

**Sensitivity:** The Agfa Magneton Tape FS for tape speeds of 19 and 9.5 cm/sec. has a sensitivity of +14+−1 db for 1 kc/s, measured at 76.2 cm/sec. optimum premagnetization and related to the standard broadcasting tape (+−0 db).

The Agfa Magneton Tape FS has a frequency response of at least +5 db.

**Distortion factor:** The distortion factor is lower than 0.5%, measured as proportion of a 3rd harmonic (3 kc/s) of 1 kc/s. Thus, the low distortion factor of the "FS" Tape ensures a particularly good and undistorted reproduction.

**Modulation noise:** 30 db.

Agfa Magneton Tape FS is supplied as follows:—

1. 1200 ft. on plastic spool with green or red starting tape. Price 54/6.
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an amount proportional to the percentage of corrosion on the surface of the elements and the frequency of operation.

The Magna-tenna circuitry is adjusted for resonance on each channel. This results in a high signal-to-noise ratio. Further, it is so highly resonant that it precludes cross-modulation between channels and, of course, prevents IF signals from entering the receiver.

With the regular indoor or outdoor antenna these problems often require stubs and filters to eliminate the interference.

In tuning the magnetic antenna—by moving the magnetic core through the coil—various pickup patterns are developed which enable it to select different wave-fronts within its small aperture area. By being able to select various aperture areas, it is possible to remove a ghost from the picture by tuning the antenna.

In practical application as an indoor antenna, the consumer is instructed to tune slowly for best picture. Many times the best picture is not where the channel is normally expected on the dial. This is especially true in critical areas, as the best pickup pattern to discriminate against reflections is not necessarily the point of resonance.

## DIRECTION FINDER

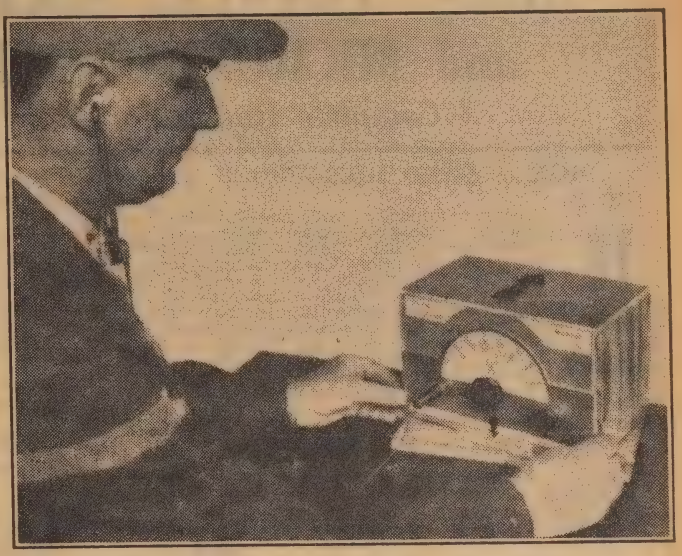
In the marine direction finder shown in the accompanying photograph the directional antenna is a standard loop stick feeding into a receiver which comprises of two RF stages, a detector, and output stage. The circuit diagram is reprinted below, but any sensitive receiver with good selectivity would be satisfactory.

The construction of the unit is such that the receiver and the compass rose can be rotated without disturbing each other. In constructing the cabinet only a few small nails should be used to hold the cabinet together while the glue sets. Also the case should not be painted with a metallic paint as this may upset the null point indication.

As regards the operation of the unit the author of the article gives the following details.

There is nothing complicated about

# A COMPACT DIRECTION FINDER



The complete direction finder in operation. Note the compass card beneath the cabinet and above the base proper. This allows the reading obtained from the finder to be related to the ship's compass. Arrow on top indicates direction of station.

radio direction finding. All you do is to use the figure-eight response pattern of a loop antenna to determine a "line of position". Diagram shows the pattern of both the old and new loops.

Contrary to communications-antenna operation, where the line of maximum response is used, the "null" or line of "no signal" is used in direction finding. It is sharper and easier to detect by ear than the centre of the broad-nosed maximum-response part of the curve.

Adding a loop antenna to a radio receiver is all that is required for a rudimentary direction finder. Include a means for reading the vessel's compass heading and angular displacement of the transmitting station, and you have a full-fledged direction finder. In a compact design it is not necessary to rotate the loop. The entire set can be swivelled on a degree-calibrated rotary platform (see photos) to find the null line.

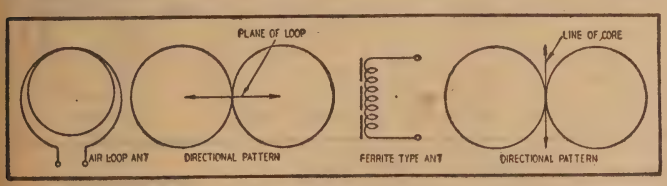
Radio stations are tuned in conventionally, and the degree-marked compass rose (seen on the base) is set to the same heading as the boat's steering compass. The equipment is then rotated until the signal fades out. On this null setting, the station will have a compass bearing as indicated by the arrow under the tuning knob. This bearing line can be laid out, running through the transmitting station, on a chart to establish a line of position.

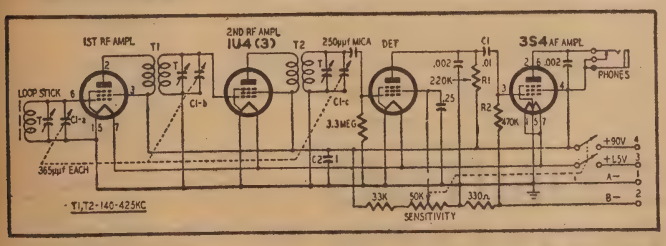
## GETTING A FIX

A similar bearing taken on a second station will provide another line of position. The point where the lines intersect is the boat's position or a "fix". Using this method there will be no trouble from reciprocal (two-way) bearings due to the bidirectional characteristic of loop reception.

Calibration consists simply of finding and marking the dial locations of the different key frequencies within range of the set. Use of a lettering guide will result in a profesional-looking dial. A coat of clear lacquer will preserve the markings.

When the equipment is used aboard a boat, it is necessary to line up the base, either fore and aft or at right angles to the keel, with the beam. Tune in a station and turn the direction finder until you find the null. Through the centre line of the direction finder runs the line of the station. With another bearing on a different station, the crossing of the lines on the chart will show exactly where you are.




Top: Polar diagrams showing the difference between the conventional loop and the ferrite rod, the former being on the left, the latter on the right. Above: The circuit diagram of the receiver, though any similar circuit would be quite suitable.

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Designed to meet even the most exacting requirements, this Microphone incorporates the world famous floating crystal sound cell construction. Its special characteristics are that its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise.

SPECIFICATION

Recommended load resistance—not less than 1 megohm.
Output level —65 db ref. 1 volt/dyne/cm².
Frequency response—substantially flat from 30 c.p.s. to 10,000 c.p.s.
Directivity—non-directional.
Size—2-1/8in spherical diameter.
Connector—Standard international 3-pin.

**£24/19/6**

## GENERAL PURPOSE

MIC 35

The MIC 35, undoubtedly the best value ever offered, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5000 c.p.s.

**£2/15/-**

SPECIFICATION

Output level: —55 db ref. 1 volt/dyne/cm².
Cable—approx. 4ft. of co-axial supplied.
Weight—6ozs. unpacked, 7 ozs. packed.
Dimensions—microphone only 2¼in x 2¼in x ⅞in.

## TABLE or STAND MICROPHONE

MIC 22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the quotation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost.

SPECIFICATION

Output level = —50 db ref. 1 volt/dyne/cm².
Output impedance—equivalent to approximately 0.002 uF (0.8 megohm at 100 cycles).
Frequency response—substantially flat from 40 to 6000 c.p.s.
Recommended load resistance—not less than 1 megohm, dependent on low frequency response.

**£9/18/6**

## LAPEL MICROPHONE

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.

MIC 28

Output level—approx. —55 db ref, 1 volt/dyne/cm².
Recommended load resistance—5 megohms.
Frequency response—level throughout the whole of the audible spectrum.
Capacity—0.0015 uF. at 1000 c.p.s.
Impedance—100,000 ohms at 1000 c.p.s.
Cord—6ft. shielded cable.
Size—1-9/16in wide x 2¼in long x 5/8in thick.

**£5/19/6**

## HAND or DESK MICROPHONE

MIC 33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7000 c.p.s.

**£6/18/6**

## CRYSTAL MICROPHONE INSERTS

MICROPHONE INSERTS

(MIC 32 illustrated)

These inserts are available in varying sizes ranging from as small as 15/16in square to 1-13/16in round, with various thicknesses from 7/32in to 9/16in. Suitable for every purpose such as hearing aids, public address, tape recording, amateur broadcasting, etc., they have responses from 2250 c.p.s. to 3500 c.p.s. at 5 db to 30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC 32 insert, **£2/15/6**; all others, **£1/19/6.**

MICROPHONE INSERTS

(MIC 23 illustrated)

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# NEWS AND VIEWS OF THE MONTH

## Tanks follow blast

TANKS can pour through an enemy line shattered by an atom attack in the same way as they exploit conventional bombing.

This was shown in US Army manoeuvres during atom tests in Nevada.

Armored troops had to break through the atomic "battlefield" within minutes of the detonation.

The tanks had to turn away from the explosion point at about 1000 yards because of high radiation.

But the resistance of their armor plate to lethal gamma rays was better than expected.

Tanks and vehicles, carrying 460 men, had to wait with engines turned off because their vibration would have disturbed delicate instruments recording other phases of the test.

All engines started immediately after the burst, though big tank motors are notoriously finicky.

The vehicles rumbled forward through an intense dust-storm raised by the blast.

They then turned to "capture" an objective in the hills seven miles away.

Scientists in the two leading tanks used special detection equipment to determine how near might they safely approach.

Only surprise of the manoeuvre was that on Mine Mountain, 5000 yards away, the glass lenses of two huge army searchlights were fused and made opaque by the blast.

The searchlights were sheltered behind a 55ft ridge with their glass faces turned away from the detonation.

Armored force officers summing up the results of the test, said atomic warfare was not expected to make any radical changes in tank tactics.

## Sydney police to FM

THE police radio network will change to a frequency modulation system in the VHF bands.

The FM equipment will give the police radio advantages over its present radio facilities.

Installation of the equipment will begin in about eight weeks.

Police probably will broadcast on FM for the first time in six or eight months.

But the complete change-over will take three years to complete.

The officer in charge of the police radio (Sergeant A. L. K. Glasscock) said that FM widely used in overseas police forces, would permit direct conversation between police patrol cars, and increase the range of transmission and reception.

At present the police radio uses a base station operating on 1700kc, just below the broadcast band.

The cars talk back on a frequency of about 29mc.

The police have used this system since long before the war, and have been considering a change to more modern methods for some time.

## Jet transport 1962

GENERAL use of jet aircraft for commercial flying is unlikely before 1962, according to Mr. James Boyce, sales manager of Lockheed Aircraft Corporation, California, who recently visited Australia.

"Piston-engined aircraft will continue to ring the cash registers for airline companies till 1959 at least," he said.

"Turbo-prop planes will then take over till about 1962, when they will make way for jets.

"Even then, turbo-props will still have a big future ahead of them as freight-carriers."

## Wot! no wires?

A MINIATURE earphone device has been invented which permits freedom of movement to a listener hearing a "silent" radio program.

The Foot Induction Phone was recently on exhibition at the Museum of Applied Arts and Sciences, Harris Street.

It is a non-electrical miniature earphone for radio listening.

Termed a stethophone, it fits comfortably to the ears and permits freedom of movement to a radio program listener.

Not connected to wires, batteries or cords, the phone depends on sound reproduction through space by magnetic transmission.

The operating field is created by a loop of wire encircling the building or room, and fed by the current which normally supplies the radio loudspeaker.

The magnetic force is not obstructed by walls.

The phones are of particular value to patients in hospitals.

## POPULAR SCIENCE QUIZ

*Q. Is a cobalt-bomb a practical possibility?*

Yes, such a bomb is quite practical and its possibility has been known to scientists for several years. However, it is hardly likely that such a bomb will ever be made or detonated, even experimentally, unless the world's leaders really go mad.

The actual mechanism of the cobalt-bomb would not differ from that of any of the nuclear bombs we have today. (Atom-bombs, H-bombs, &c.) The difference would lie simply in the casing of the bomb, which would be of ordinary cobalt.

On detonation the cobalt would be vaporised and the tiny particles converted to radio-active cobalt (cobalt 60). Since cobalt 60 has a half life in excess of five years, such a procedure would be equivalent to scattering vast quantities of radium throughout the universe to cause death and injury wherever it should happen to blow. It would be just as likely to injure the attacker as the attacked.

*Q. Has cobalt 60 any peacetime applications?*

It most certainly has. Normal cobalt is easily converted to cobalt 60 in the atomic furnace and then forms a very effective substitute for the rare and expensive radium which medical science and others have been forced to use so far. It is now perfectly feasible for a single hospital to have available more radiation than would be obtained from the world's entire supply of radium.

In addition to the treatment of cancer and other diseases normally requiring radium, the cobalt 60 makes possible extremely portable x-ray plants which require no power supply and are small enough to carry anywhere.

*Q. Are there any other substances similar to cobalt 60?*

The latest effort along these lines is the production of radio-active caesium, or caesium 137. Scientists have so far produced only a little more than two ounces of this material, yet it has more radiation energy than a pound of radium, worth over half a million pounds at present prices.

Caesium 137 has a life of 37 years, compared with cobalt 60 at a little over five years and radium at 1600 years.

*..Or is there any cure for the effects of radiation on the human body?*

Although there is little that can be done at the present time to cure the effects of severe radiation, scientists have not been idle on this problem. Already they have succeeded in curing radiation sickness in mice and the means by which this was achieved and the body processes are being carefully studied in an attempt to relate these findings to humans.

The mice were cured of their radiation sickness by a spleen protective factor obtained from the spleens of young mice. How the spleen factor works, which would help toward making a radiation sickness medical cure, was discovered with the aid of radioactive carbon-14.

This was used as a tag for a formate chemical. The tagged formate was injected into the mice which were then exposed to x-rays. These mice suffered from radiation sickness, due to the inability of the body cells to divide and grow. Mice treated with spleen protective factor were found to have normal cell division and growth after seven days.

# TWO NEW Fluxmaster models

These new versions of Australia's two most popular loudspeakers — Models 5C and 5F — now employ the Rola Fluxmaster principle.

Its introduction in these models has raised their already high efficiency yet reduced their cost to a point where, without question, they represent the best value for money in the 5" speaker group.

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## Cosmic ray telescope

USTRALIANS at Mawson, on the Antarctic mainland, are operating the world's largest cosmic ray telescopes.

The expedition's physicist (Mr. Neville Parsons) has recently completed assembling two directional cosmic ray telescopes.

Dr. Geoffrey Fenton and colleagues of the University of Tasmania's Physics Department took two years to make the telescopes.

The ice ship Kista Dan landed them at Mawson last February.

The telescopes are mounted on converted anti-aircraft gun mounts set in concrete piers weighing four tons, and contain 230 radio valves and 150 Geiger counters.

They are housed in a specially designed laboratory capable of withstanding winds of 150 miles an hour.

Scientists at Mawson will now be able to make a continuous study of cosmic ray intensity.

This work marks another major step forward in the important scientific program being carried out by Australia's Antarctic team.

## Using the jet stream

THE US military and civilian pilots have made a start toward turning the jet stream into an aerial super-highway across the Pacific.

Fully harnessed, the jet stream could be a powerful weapon in a future war, carrying high-altitude bombers across the ocean in half the time they require today.

The stream, three miles deep and 200 miles across, rushes eastward at speeds up to 400 mph.

Nobody has yet ridden the core of the stream, but planes have used some of its currents as tail winds of 150 mph.

Pan-American World Airways started using the winter jet stream two years ago, and now averages 10 to 11 hours on the flight from Tokio to Honolulu.

## Australian TV the best

AUSTRALIAN television cameras would use the most sensitive tubes in the world, said Mr. G. J. Parker, giving the second lecture in the University of Technology's post-graduate course in television.

Mr. Parker said Australian television cameras would use an image-orthicon tube.

The image-orthicon tube gave greater sensitivity than Super XX film gave to the ordinary photographer.

The tube cost between £500 and £600.

Mr. Parker also described a smaller tube, the vidicon, for industrial television.

The vidicon tube would enable manufacturers to watch processes too dangerous for first-hand observation.

Banks, business houses and police forces also would use the vidicon.

Banks would use it to flash images of signatures to other branches.

The tube would enable police to transmit pictures, fingerprints and records of wanted criminals from station to station.

Mobile television units with vidicon tubes could flash images of crime scenes to police headquarters.


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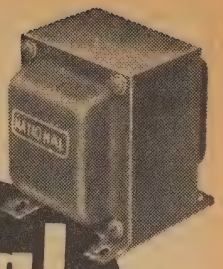

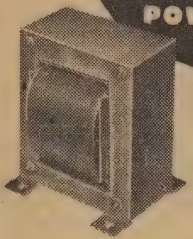

MANUFACTURED by a specialised factory employing the latest winding techniques National Power Transformers embody the best materials consistent with modern practice. They are used exclusively by many of the largest radio manufacturers.

| Type | Primary | mA | H.T. Volts | Filament Ratings | Mounting |
|---|---|---|---|---|---|
| U or F30/150 | 230/240 | 30 | 150/150 | 6.3v/1.7a | Midget U. or F. |
| U or F40/150 | " | 40 | 150/150 | 6.3v/2a | Upright or Flat |
| U or F40/285 | " | 40 | 285/285 | 6.3v/2a 5v/2a | Upright or Flat |
| U or F40/325 | " | 40 | 325/325 | " " | Upright or Flat |
| U or F50/225 | " | 50 | 225/225 | 6.3v/2a | Upright or Flat |
| U or F60/285 | " | 60 | 285/285 | 6.3v/2a 5v/2a | Upright or Flat |
| U or F60/325 | " | 60 | 325/325 | " " | Upright or Flat |
| U or F60/385 | " | 60 | 385/385 | " " | Upright or Flat |
| U or F80/285 | " | 80 | 285/285 | 6.3v/2a 6.3v/2a 5v/2a | Upright or Flat |
| U or F80/325 | " | 80 | 325/325 | " " " | Upright or Flat |
| U or F80/385 | " | 80 | 385/385 | " " " | Upright or Flat |
| U or F100/285 | " | 100 | 285/285 | 6.3vct/2a 6.3v/2a 5v/2a | Upright or Flat |
| U or F100/325 | " | 100 | 325/325 | " " " | Upright or Flat |
| U or F100/385 | " | 100 | 385/385 | 6.3vct/2.5a 6.3v/2a 5v/2a | Upright or Flat |
| U or F125/285 | " | 125 | 285/285 | 6.3vct/2a 6.3v/2a 5v/2a | Upright or Flat |
| U or F125/325 | " | 125 | 325/325 | " " " | Upright or Flat |
| U or F125/385 | " | 125 | 385/385 | 6.3vct/2a 6.3v/2.5a 5v/3a | Upright or Flat |
| U or F150/285 | " | 150 | 285/285 | " " " | Upright or Flat |
| U or F150/325 | " | 150 | 325/325 | " " " | Upright or Flat |
| U or F150/385 | " | 150 | 385/385 | " " " | Upright or Flat |
| U175/425 | " | 175 | 425/425 | 6.3ct/3a 6.3/2a 5/3a | Upright |
| U200/385 | " | 200 | 385/385 | 6.3vct/3a 6.3/3a 5/3a | Upright |
| U250/385 | " | 250 | 385/385 | 6.3vct/4a 6.3/3a 5/3a | Upright |
| *T80/265 | " | 80 | 265/265 | 6.3vct/2a 5v/2a | Upright |

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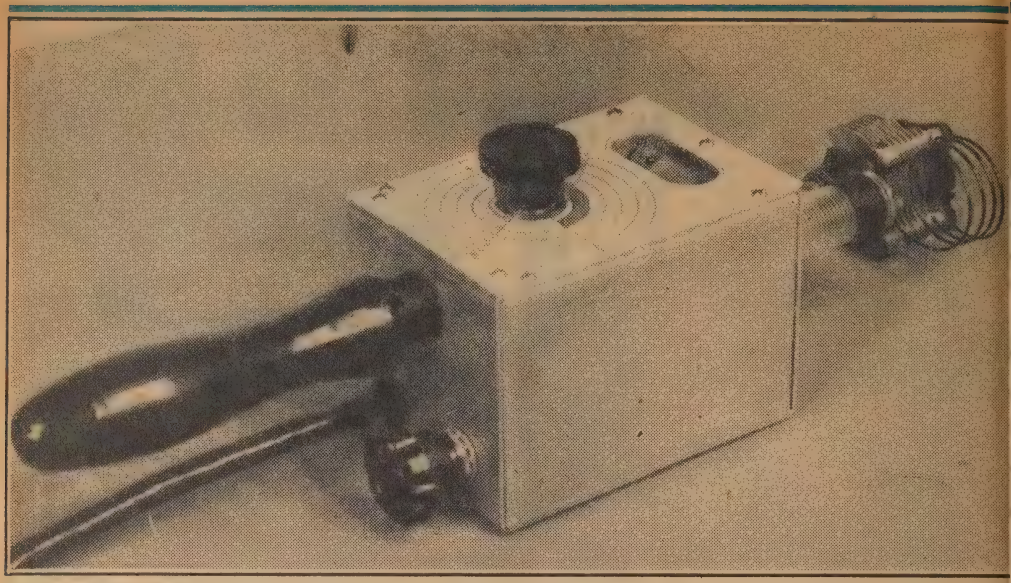


The grid dip meter in a typical application—the checking of a resonant circuit to determine the exact frequency. The need to check circuits in this way will be experienced time and time again during the construction of a transmitter or receiver.

# CALIBRATING THE G-D OSCILLATOR

**Following last month's article on the construction of an AC operated grid dip oscillator we are concentrating this month on some minor modifications which some may prefer, plus various calibration procedures to assist them with this important final phase of construction.**

FIRST, the modifications.

As mentioned last month, we had some ideas about winding coils for the higher frequencies on smaller formers.

The advantages of this technique are, firstly, the smaller physical size, which is valuable when probing into the compact gear normally used at the higher frequencies.

Second, and perhaps more important, is the better coupling which is possible between coils of approximately the same size, as compared with coils of greatly differing sizes. Since most high frequency coils are small physically, the larger (1¼in) formers are something of a disadvantage for the higher ranges.

## BOTH SIZES NEEDED

On the other hand, these formers are virtually essential for the lower frquencies, where many turns are required, and it becomes necessary to evolve a scheme whereby different sized formers may be used in conjunction with a single six-pin socket.

We solved the problem by using a readily available ¾in plastic former and mounting it on a standard six-pin speaker plug. These formers are provided with a 5/32in Whitworth thread in the base (originally intended to accommodate an adjustable iron slug) and which is ideally suited to our purpose. It is merely necessary to drill a 5/32in clearance hole in the centre of the six-pin plug and fasten the two together with a ½in x 5/32in countersunk screw.

## ASSEMBLY CARE

The only precaution concerns the pressure exerted when tightening this screw. The amount of bakelite in this portion of some plugs is not very great and easily broken, if one is too heavy-handed. It is not necessary, or advisable, to counteresink the hole to accommodate the head of the screw. Such a procedure only weakens the already thin wall, while there is ample room for the head between itself and the socket.

Provided these precautions are observed, and remembering that the wires from the coils will add som strength to the assembly, it is pos sible to make a perfectly rigid com bination.

The formers are available eithe grooved, at 16 turns per inch, o plain, thus being suitable for eithe spaced or close winding respectively.

The exact winding details of thes new coils will be found in the ac companying panel. We designe them so that as many as possible o the amateur bands occur at the lo frequency end of a band, where th calibration spread is greater an there is less chance of stray capac tance altering calibration.

This arrangement puts the top fre quency limit with coil "A" at abou 87 Mc, though it is possible to g higher than this. We tried a singl turn coil and pushed the limit to 10 Mc.

## SMALLEST COIL

To find out just what could b done we prepared a "coil" in th form of a hairpin about two inche long and self supporting in the six pin plug. It was centre tapped i the middle of the curved portion an made from 16-gauge tinned coppe wire for rigidity. This pushed the to limit to 117 Mc, which is higher tha

by Philip Watson

expected from this circuit. How-
; performance at the lower fre-
ncy end of the band, using this
was erratic and prone to drop
of oscillation.

his, therefore, appears to be the
limit with this general layout.
his stage the tuned circuit is com-
d more of stray capacitance and
ictance than anything else and
e is more inductance in the leads
he coil than the "coil" itself. It
ld be possible to shorten the leads
ocating the coil right at the plug,
this reduces the effectiveness of
instrument, making it difficult to
ple it effectively to another cir-

hether the hairpin coil would be
much value will depend largely
individual requirements. Since it
s not extend the range into the
t amateur band (144Mc), it is
y likely to be useful in special
es and we are mentioning the pos-
lity purely as a matter of inter-

eturning to the tabulated data,
coil A, it may be found neces-
y to prune this slightly one way or
other, according to the stray
acitance and inductance associ-
d with the oscillator wiring. The
portant thing is that it overlap the
t lower coil no more than neces-
y—say, about 1 Mc—and thus ex-
d as high as possible at the other
of the scale. The remaining coils
uld be less critical by reason of the
ger proportion of inductance and
y capacitance being in the coil
lf.

## AIN FORMER

A plain former is best used for
s coil. If a grooved one has to be
d, drill holes no larger than the
meter of the winding wire. In any
e, two holes will need to be drill-
one above the other, to form the
t and finish of the winding. On
opposite side of the former an-
er hole will be needed to take the
tre tap. It will also be necessary
drill three holes in the bottom
the former to correspond with the
ee pins to be used.

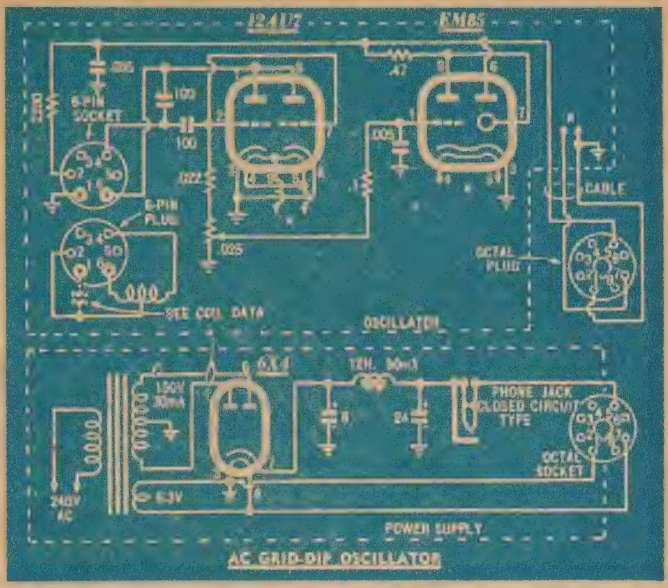
t will be very much easier to
d a neat coil if the wire is free
n kinks and this is achieved by
tching a short length of it with
end held in a vice. It also helps
en winding the coils to hold one
of the wire in the vice.

fter the coil is wound, but before
base is mounted, the centre tap
itted. Scrape the enamel from the
e where the tapping is to be
de, apply a little paste flux and
quickly with a hot iron. If done
efully there is no danger of
naging the former. A short length
wire with the end previously
ed may now be passed through
hole from inside the former and
two quickly soldered together.

fter the six pin plug has been
unted and the wires soldered into
pins, but before the wires are
mmed, grip each wire in the vice,
neat the soldered joint, and exert
t tension on the wire until the
t cools. This will help to make
whole assembly rigid.

oil B, (13.5 K 35.5 Mc) is wound
a grooved former and it is easy
calculate beforehand where the
ious holes need to be drilled. This
presents no particular problems.

# GRID-DIP OSCILLATOR CIRCUIT




**To provide a handy reference while reading this article we are reprinting last month's circuit. Note the polarity of the tuning capacitor which can be critical on the highest frequency band. All tuned circuit leads must be as short as possible.**

Coils wound on plain formers should be "doped" in some way to fasten the windings to the former and prevent change of inductance after calibration. Ordinary cellulose cement or clear nail lacquer will serve and it need only be applied over the ends of the windings.

## LARGER COILS

We considered it sufficient to wind these two coils on the smaller formers, retaining the larger ones for the remainder. If desired, the next coil could also be wound on the smaller former, and details for this coil on both formers are included in the coil data.

The other modification was to fit one of the more expensive imported tuning capacitors. Whether this will be necessary in all cases is for the individual to decide, but the following points may help.

The better types are more rigidly constructed, giving more stable calibration and smoother rotation. They also have a more desirable frequency law, the "straight line capacity" law of the cheaper types tending to crowd the calibrations badly at the high frequency end. Although the new law is not completely "straight line frequency" it is considerably better.

Against these obvious advantages is the cost of the unit, which may be two or three times as much as the cheaper variety. If this is no objection, then it may be regarded as a worthwhile investment.

Mounting the new condenser will call for a slightly deeper bracket to allow for the longer mounting bush. This can be easily fashioned from a scrap of aluminium. Leads should be kept as short as possible, and the grid connection should be to the fixed plates. Failure to observe these points may result in erratic performance at the low frequency end of the high frequency coil.

A few details about the scale may assists in making the best use of the available space. Our scale consisted of six concentric circles, the largest being 2 13-16in diameter and the others being each progressively smaller by 3/16in. This provides five actual scales, but the one nearest the centre is largely hidden by the knob and is of little use for calibration markings. However, it has another use which we will mention in a moment.

## EIGHT SCALES

This leaves four 360 degree scales or eight 180 degree scales. Only seven are normally required, though the eighth may be useful if an extra high frequency coil is used.

Although the use of a double pointer provides us with twice the number of scales, it has one disadvantage. Due to the tuning capacitor being a continuous action type it is quite possible to rotate the whole system through 180 degrees and completely transpose the pointers with respect to the calibration markings.

Where the imported tuning capacitor is used there is a further problem. As already mentioned these units are designed to give an improved frequency law. This is achieved by shaping the fixed plates, as against the more usual practice of shaping the moving plates.

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1in x 5/8in x ½in.
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9/10.
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2 Amps.
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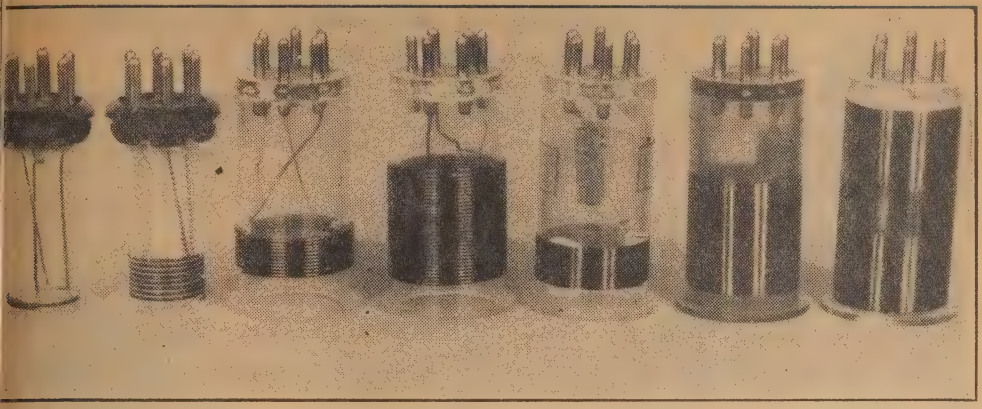

complete set of coils made to the data published in the panel below. The VHF coil is on the left and the IF and lower frequency broadcast band coil on the right. Note the small formers mounted on the six-pin bases.

ecause of this, and because the ing plates can rotate through degrees, it can happen that the ing plates will engage the fixed es on either their broad or ow side.

he correct law is only obtained n the narrow side is engaged . If the reverse occurs, the law be reversed and the calibration ing worse than ever.

o avoid this we colored 180 ees of the innermost scale (pre- sly mentioned) in red, and pro- d a spot of red paint on that ion of the pointer which norm- moves above it. To provide even ter contrast we suggest coloring other half green with a green on the pointer.

## ALE MOUNTING

nother important point is the nting of the scale. This may be e by means of the four self tap- screws which hold the sides the box, but this arrangement e has one disadvantage. If ever sides of the box need to be oved for servicing the scale will eleased and may not be replaced exactly the same position, thus acting from the accuracy of the rument.

e overcame this by fitting three e self tapping screws, two below scale and one above the indicator out, which are used solely to the scale in place. An alterna- suggestion is to glue the scale to top of the box.

he next point to be considered is actual calibration. The method loyed will depend to a large ex- on the available standard against ch the new unit is to be checked we propose to discuss several he more popular schemes.

lthough the natural inclination use the highest standard avail- , it should be appreciated that grid dip oscillator is not cap- of being calibrated with the e degree of accuracy as, say, a fully designed and built fre- ey meter. In other words it is ntially a second order standard ch is expected to provide reason- accuracy, but by no means one which would be taken as the last word in a ham shack.

For this reason there is no point in delaying the calibration in the hope of obtaining an "ultra-accurate" standard, while standards of sufficient accuracy are already available. Suitable standards would be a signal generator or service oscillator, a commercial communications receiver such as the AR8, or even a home-built set if it has been reasonably well calibrated.

If you are fortunate enough to possess a Bendix, or similar frequency meter, by all means use it, but it is not essential.

Initially, while the coils are being wound and adjusted, it will merely be necessary to make a reasonably accurate check on the limits of each band to ensure adequate overlap and, where desired, coverage of a particular band.

This may be done by using a calibrated absorption wavemeter, although the latter's calibration is not normally very accurate, and far below that of which the grid dip meter is capable. For better results other methods should be used.

If a signal generator is to be used it will be necessary to provide some means of comparing the two frequencies. This may be done by means of a receiver which covers the bands involved or by other means. The receiver is a good idea if one is available, and its own accuracy is of little importance. It is only necessary to couple the signal generator to it and then adjust the grid dip oscillator until the two signals beat together.

The grid dip oscillator will normally have enough output to make any physical coupling unnecessary. Operating it alongside the receiver should suffice. Naturally it will be necessary to avoid confusion due to double spots &c., and these are best minimised by keeping all input signals as low as possible.

## UNTUNED DETECTOR

A simpler arrangement, and one which we found to be very convenient, is to provide some kind of untuned detector circuit ahead of an ordinary audio amplifier. We used a germanium diode clipped into the audio lead from the Senior Signal Tracer, but any audio amplifier circuit with reasonable gain will suit.

The signal generator is connected to the other side of the diode and the grid dip oscillator will generally couple to this arrangement from a distance of several feet. Such a set-up has the advantage of virtually unlimited coverage, plus the absence of any ambiguity due to second spots. It will still respond to harmonics but these are not likely to cause confusion and can be a valuable double check.

Having set the generator to a frequency representing the first calibration point on a particular band it is then only necessary to adjust the grid dip oscillator until a beat is

## COIL WINDING DATA

COIL A. 87 to 32 Mc.
1½ turns, ¾in. former, 20 B & S. wire
COIL B. 35.5 to 13.5 Mc.
8 turns, ¾in. grooved former, 20 B & S.
COIL C. 15 to 6.5 Mc.
18 turns, ¾ in. plain former, 20 B & S, winding length, 11/16 in.
COIL C. 15 to 6.5 Mc.
11 turns, 1¼ in. former, 20 B & S, winding length, ½ in.
COIL D. 6.5 to 3 Mc.
33 turns, 1¼ in. former, 20 B & S, winding length, 1¼ in.
COIL E. 3 to 1.4 Mc.
54 turns, 1¼ in. former, 32 B & S, winding length, ½ in.
COIL F. 1.4 to .7 Mc.
1¼ in. close wound 32 B & S, 1¼ in. former,
COIL G. .7 to .45 Mc.
2¼ in. close wound 32 B & S, 1¼ in former,
25 pf capacitor in parallel with winding.
All coils wound at top of former.
All coils centre tapped.
Centre tap of coils D, E, F, and G by-passed to pin 1 with .001 mfd capacitor.

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SPECIFICATIONS:

Output 10 watts.
Distortion less than 0.1% at 8 watts.
Frequency response overall 50-100,000 cycles.
*Fully tropicalised.*
Partridge output transformer.
Flat response within 1db from 15-30,000 cycles.
Tubes: EF86, ECC83, 2/EL37, (616) Triode tetrode Ultra linear connected.
GZ 32 indirectly heated rectifier.

***PLUS*** 15db base or treble boost!
***PLUS*** Audio Filter!
***PLUS*** Multiplex Input!

As a check, set the generator ıer a higher harmonic, to beat harmonics from the grid dip tor; or a lower frequency when ınics from the generator will with the fundamental from the dip oscillator.

e the first calibration point is ished beyond all doubt the ator is simply moved up by a le amount, followed by the ıtor. Naturally, as many cali- n points as possible are desir- but there is no point in crowd- e scale unduly. For this reason, ons which are perfectly logical e end of a scale may be too led at the other end.

## R LIMIT

ny signal generators do not ex- beyond about 30 Mc but it is ctly satisfactory to operate on ınics provided one or two mark- ints can be checked positively.

the higher frequencies only a small deviation is necessary in to produce an audible beat, tuning becomes fairly critical. it is quite possible to pass a check point if adjustment is apid.

a good communication receiver be used directly for calibra- it is only necessary to operate grid dip oscillator reasonably to the set to obtain an indi- n in the latter. Since the os- or is not modulated, it will ecessary to use the BFO or tun- meter to indicate exact reson- . The oscillator can radiate a substantial signal at a dis- e of a few feet, and there may danger of double spots if the ver is prone to this trouble.

ıe true signal will always be ger than the image, although latter may be strong enough ɔe mistaken for the former if receiver gain is high. It is wise heck each side of a signal for istance equal to twice the IF, if possible, find the second . Once it is found and the tive strength of the signals ob- ed there is less chance of con- n.

ıe BFO should be set to the e frequency as the receiver's IF nnel, otherwise there will be reading error equal to the unt by which the BFO frequency rs from the IF.

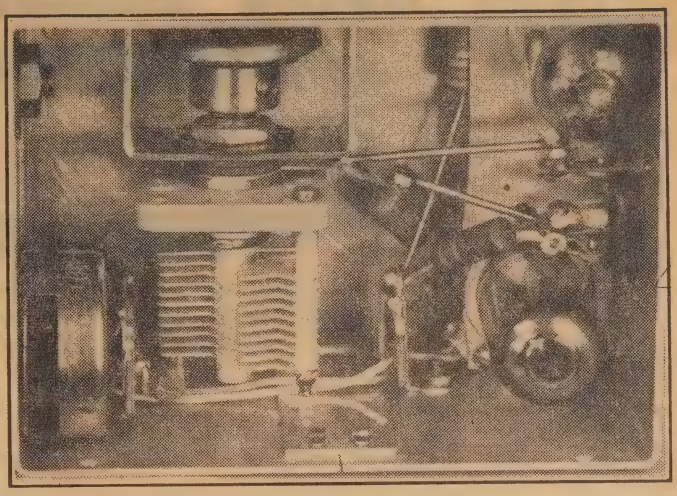
ıe limitation of most receivers at the high frequency end of band, as they normally finish bout 20 or 30 Mc. There is not much that can be done to over- e this, other than to calibrate ar as possible with the receiver leave the remaining calibration l a generator or other means vailable.

reliminary checks sometimes re- what appear to be "sub har- ics" from a generator operating say, 60 Mc and appearing on eceiver tuned to 30 Mc. More ful checking will show that the -to-one relationship is only ap- ximate and that the signal is to the difference between local llator harmonics and generator monics.

nce the IF remains constant le the other frequencies are bled the relationship is not a harmonic one.

a frequency meter such as a dix BC-221 is to be used for cking, it will normally have its detector and audio amplifier.

# MODIFIED INTERIOR OF METER



This interior shot shows the ceramic insulated tuning capacitor fitted in place of the one shown last month. In addition to improved electrical and mechanical features it provides a better frequency law.

It is only necessary to plug in a set of headphones and provide sufficient coupling to the oscillator in order to observe the beats between the two instruments.

It is important to realise that frequency meters invariably operate from a single fundamental frequency range, depending on harmonics for higher frequencies. For this reason a considerable amount of ambiguity is possible unless one has some means of positively identifying the approximate fundamental frequency of the oscillator.

## ROUGH CHECKS

This may be done in a number of ways and a high order of accuracy is not essential. One of the best methods appears to be by means of the absorption type frequency meter, which is completely free from ambiguity.

Alternatively a receiver may be used, even if it is only capable of covering the restricted amateur bands with any degree of accuracy. Again, a signal generator, even if its absolute accuracy is in some doubt, will serve to establish the order of frequency.

Once a definite check point is established, the frequency meter may be set to a suitable frequency and used to provide calibration points at regular intervals across the scale. The best scheme is one where the meter uses a 1 Mc check crystal and this may be used to provide calibration points every 1 Mc for as far up the scale as the harmonics are useable.

If the crystal is an odd frequency (as in some home made units) it may not be of much use directly and the tuned circuit will have to be employed. With the Bendix this covers from 2 to 4 Mc, and will provide repeat points separated by the frequency to which it is tuned.

It is handy to start with the meter tuned to 2 Mc, so that check points will fall every 2 Mc throughout the scale being calibrated.

With these points established, the meter can be set to 2.5 Mc and will provide signals this distance apart. Of particular interest among these are the 5 and 10 Mc points, the odd multiples being easily recognised by reason of their position relatives to the previous 1 or 2 Mc markings.

## DRAWING THE SCALE

The actual markings on the scales will probably have to be hand lettered in most cases. Provided you are even reasonably proficient it is possible to make quite a neat and attractive job. If you feel your skill is lacking or you want something which looks a little more professional you can try a lettering guide, which, with a little practice, will enable you to produce really neat figures. You will probably need the smallest you can obtain.

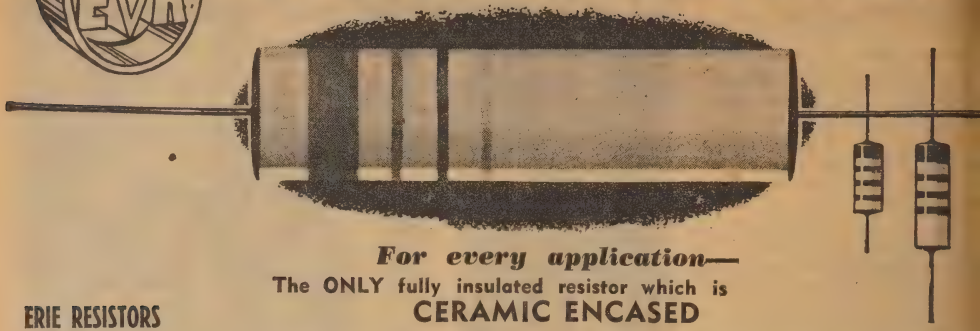
It is a good idea to mark each coil with the range which it will cover as well as an identifying letter corresponding to those used to identify the scales on the instrument. This makes it much easier to select the right coil and scale for a particular job.

## COLORS

Another idea is to use colors to identify the coils and scales. The larger coil formers, at least, are normally available in a number of colors. By selecting a different color for each band and coloring the corresponding scale with the same color it will be found that one's eye is automatically guided to the correct scale.

The scales may be colored by means of transparent inks or, better still, photographic oil or water colors which are both transparent. Where plain formers only are available a dab of color where it is easily seen will serve nearly as well.

# ERIE RESISTORS..



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# FROM THE SERVICEMAN WHO TELLS

**t frequently happens that the interest in a service case lies not so much in how the fault is located and fixed, as in the basic theory behind the symptoms which it exhibits. Such a case is one I have this month, plus one of the rarer cases where modification of the original design seemed justified.**

Y first story concerns an American AC/DC set, which was ier more elaborate than the usual of sets of this type, at least in country. It was a fairly large itel set—perhaps a table model ld have been a better term—emring two 50L6's in a push pull ut stage and having two short-e bands in addition to the usual adcast band.

was completely inoperative as received it. The owner's story that he had already taken it to serviceman who diagnosed eral faulty valves and advised the ier that these were unobtainable that there was nothing which ld be done for the set.

ust what prompted these ions, or whether the story I rd was an accurate version of the riceman's comments, I will prob-never know. All I do know is they seemed to be at variance h the facts as I found them.

## LVE CONDITION

n the first place the valves which been condemned, as well as all other valves, tested good. ondly it is hardly correct to say these valves are not obtain-. Admittedly they may not be ked on every dealer's shelves the 5Y3 and the 6V6, but they generally be obtained from valve ufacturers, who if they do not e them, normally import small ntities for just such replacement poses.

aving explained these points to owner, he felt a good deal hap-. He was particularly anxious get the set going again, since it eared that he was something of a t-wave fan and claimed that the had an excellent short-wave perhance. Since there now seemed be a reasonable chance that it d be fixed, he told me to go ad and do what was necessary.

he first thing to do, before I ld switch it on, was to deter-e which was the neutral (or ssis) connection of the power and which was the neutral (or hy) side of the bench power et. As it happened, I had to spose the leads in the plug.

## /DC SETS

rankly, I do not like AC/DC sets. idea of a great piece of metal a chassis that can just as easily ied as bypassed to the live side the mains has much the same ct on me as spiders and other wly things have on my better .

ut sentiment cannot be allowed interfere with business and I urally handle them when they n up. Fortunately this is not n.

aving satisfied myself that the connections were right way round I plugged it in, stood clear, and switched on. There was no sign of life, no filaments, no nothin'. I unplugged it, turned it over, plugged it in again, then gingerly probed at the thing with the multimeter prods. I didn't need to probe far. AC power came into the set all right and was measurable as far as the ballast resistor. After that—nothing. Obviously the ballast resistor had "had it".

## BALLAST RESISTOR

Normally this would not present any difficult problems. It would merely be necessary to add up the total voltage of the valve filaments, subtract this from the supply voltage, and indulge in a little Ohm's Law calculation to determine the value of a replacement ballast.

Unfortunately this case wasn't as easy as all that because the ballast appeared to be something rather unusual. It was in the form of a plug-in device and about as large as one of the old time wet electrolytics. The outer cover was of perforated metal and inside could be seen some seven or eight vertical resistor spirals suspended between insulated supports at the top and bottom.

The base was similar in style to an octal, but had 12 pins. The socket was so arranged that the ballast could be plugged in three different ways, permitting operation on 110 volts, 220 volts, and 250 volts.

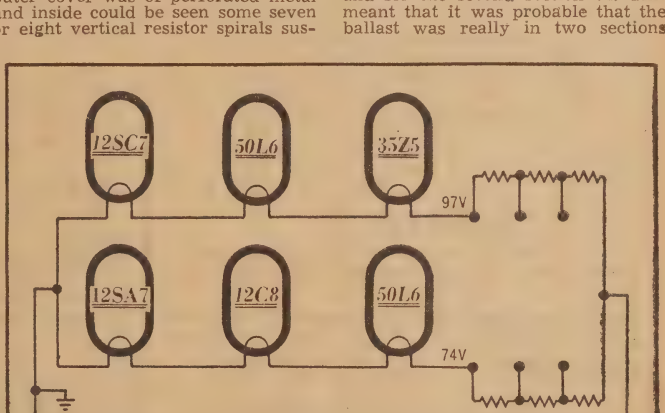
Inside the unit things were in pretty much of a mess. Apparently one section of the resistor had burnt out and the free ends had shorted to the adjacent sections burning these out also. The result was a jumbled mass of wires from which there was little hope of salvaging anything. Even the idea of a temporary repair to measure the resistor values seemed hopeless. It was a complete "write off".

At this stage I decided that it was time to examine the filament circuit in greater detail. A quick glance at the valve types was sufficient to show that the total voltage required for a simple series circuit was much higher than 110 volts. Since the set was designed to work on this voltage it was fairly obvious that the filament network must have been divided into two parallel sections.

## FILAMENT CIRCUIT

A check on the wiring confirmed this. In one section was the 35Z5 rectifier, one 50L6, and a 12SC7. In the other section was the other 50L6, a 12C8, and a 12SA7. The voltage required for the first section was 97, and for the second section 74. This meant that it was probable that the ballast was really in two sections with different values and tappings for each leg.

The whole project was looking pretty complicated by this time. While there is no real difficulty in calculating the various values of resistance necessary to make up a new ballast, the question of its physical form was another matter. The original resistors were virtually self-supporting and operating in free air. As such they could operate at




The filament circuit of an AC/DC set as it was originally. The tappings on the two ballast resistors were selected by plugging the resistor into its socket in different positions. This allowed the set to operate on a number of line voltages.

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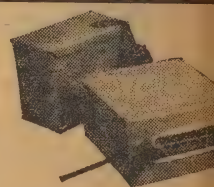
**Illustrated is Mantel Major and Kar Set.**



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gh temperature and be quite
l physically.
mmercial resistors which would
to be used for replacement
d be of quite different types
many times larger. It was go-
to be difficult enough to find
for them, anyway, but there
the added complication that, in
to retain the flexibility of the
voltage adjustment, it would
ecessary to mount them on the
of the original ballast.
is was clearly impossible and
only alternative seemed to be
t a multi-position switch to do
ame job. But it would be diffi-
to do this in the space avail-
and the cost of labor, plus
extra components, looked like
ng out of hand.
simpler approach seemed to be
rget all about the 110 and 220
tappings and simply provide
tors for 240-volt operation. This
ed logical enough, since it was
tically 100 pc certain that it
d never require these voltage
again.

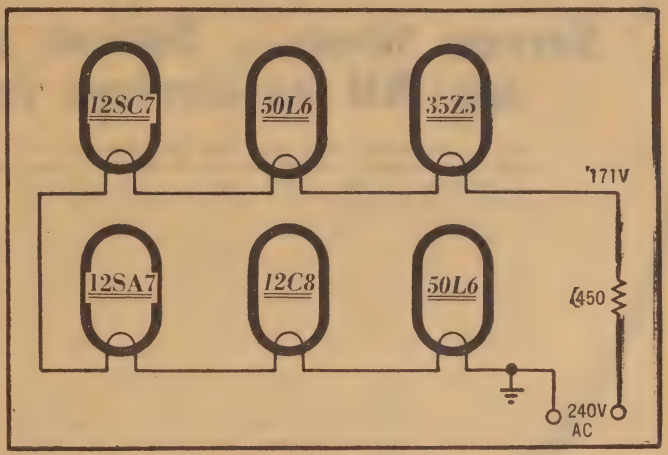
## IES CIRCUIT

suming we could accept this
ation, another idea immediately
ested itself. Why not scrap the
ent twin parallel networks and
ert the entire filament system
ne simple series circuit? As far
could see there were no ob-
ons to the idea, while there
the very real advantage that
much less power would have
e dissipated as heat and the
e arrangement would be much
efficient.
few simple calculations gave
the value of the new ballast
tor. The total voltage required
erate all the filaments in series
171 volts. Subtracting this from
gave 69, the voltage which would
to be applied to the ballast
tor. The current flow would
15 amp. Dividing this figure
69 gave me the required resist-
value—460 ohms.
e nearest commercially avail-
value to this is 450 ohms and
was regarded as close enough.
act, the difference would only
unt to about 1.5 volts across the
e filament network, which would
ell within the normal tolerances
ved for such valves and not
ly as great as would be en-
tered in normal line voltage
tions.
e resistor would have to dis-
e a fraction over 10 watts and
ndard 20-watt commercial type
selected. It is not always fully
eciated that the wattage ratings
esistors are based on "free air"
ation and that they must be
derably reduced when the re-
is enclosed in a cabinet or
r a chassis where the flow of
s restricted. Under these con-
ns the temperature can easily
to the point where either the
tor itself or an adjacent com-
nt may be damaged.

## MENT WIRING

wiring the filament was not a
cularly difficult task and there
plenty of room to mount the
resistor where the old ballast
had been. The whole scheme
ed out particularly well and
et functioned as soon as it was
hed on.
check with the meter showed
ny calculations had been cor-
rect and all filaments were receiving their correct voltage. The total HT was about 210 (due to resistance in the filter network), which was just about right for the 50L6's after allowing for bias requirements.

Checked on the air the set gave quite an impressive performance. Naturally there was no lack of power output with the push-pull arrangement, while the owners claim of good short-wave reception appeared to be fully substantiated. In fact, I felt quite mellow toward the thing, even if it was an AC/DC job!




The circuit as modified when the ballast resistor failed. It is now suitable for only one line voltage, but is must simpler and needs only a small ballast resistor dissipating approximately 10 watts. Short of a major re-build to a section of the set it was the only possible solution.

The owner was also very pleased with the performance when he heard it, the fact that I had been able to extract a little more gain from it when lining up, adding to his pleasure. I explained that I had taken the liberty of modifying the set somewhat and that it was no longer suitable for 110 or 220 volts. This didn't seem to worry him.

"If ever I can afford a trip to the States," he said with a smile, "I'll be able to afford a new one, anyway. In the meantime, this will do fine."

My next story commenced when a car—complete with radio aerial—drew up outside the shop and the owner entered, inquiring if he could have someone look at his car radio.

"What's the trouble?" I enquired.

"Well, it's rather hard to explain," he replied. "The set seems all right between stations, but as soon as I tune to a station it sets up a terrific howl. Of course, it's probably some simple thing that you can fix in a few minutes, but it sounds pretty crook at the moment."

## A BIT THICK!

"My friend," I replied, remembering with feeling the car radio I described last month, "faults in car radios are never simple. They are invariably intermittent, spread over half a dozen components, and of a type nobody has ever heard of before. In addition they never occur on the bench, only in the car, and one needs to be double jointed to service them."

From the look on his face I quickly realised that I had laid it on a bit thick and that he was taking me seriously.

"Well, perhaps it isn't really as bad as that; but I have had some curly ones lately so here's hoping yours is the exception. Let's hear it."

We walked out to the car and he switched it on. As soon as it warmed up he tuned it over the band and, sure enough, each station produced a loud howl. It wasn't the usual heterodyne whistle such as results from an unstable front end, but more like some kind of acoustic feedback.

"See what I mean," said the owner, "It's only crook on the stations. Quite all right in between."

But he was wrong. Admittedly there was no actual howl between stations, but there was a definite hollow quality about the normal noise level. The easiest way to describe it is to compare it with a PA system which is on the verge of feedback without actually spilling over.

## SNAP DIAGNOSIS

In the simplest language I could use I pointed out this additional symptom to the owner who agreed, now that I mentioned it, that it did sound rather different beween stations. Naturally, he wanted to know the significance of this and whether it indicated the nature of the fault.

Now most servicemen pride themselves on their ability to make a snap diagnosis, and I'm afraid I am no exception. The ability to "pick it in one" is something which most of us continually try to cultivate. Sometimes there are enough obvious symptoms to enable an accurate diagnosis to be made after a few minutes' thought, even though the fault may be an unusual one. More often, as in this case, it is simply a matter of previous experience.

But, however, it is done, the effect is always impressive as far as the customer is concerned and, frankly, this is not a bad thing. After all, very few members of the public

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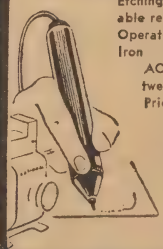

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sufficient knowledge of the art
lly appreciate just how skilled
work really is and anything
n helps in this regard is
ally justified.
us I felt a measure of satisfac-
in being able to tell the cus-
r that I was practically certain
rouble was due to faulty elec-
tics in the power supply, par-
rly the one directly across the
ine. I felt confident in doing
simply because I had seen a
ar effect on previous occasions.
expected, the customer was
impressed. He was also some-
relieved, I imagine, to learn
it appeared to be a reasonably
ghtforward fault without all
horrible complications I had
ast.

wever, another problem now
ented itself. I had promised
al customers that their sets
d be ready that day and I didn't
safe in tackling it at this stage,
to the extent of merely taking
t of the car. Even apparently
ghtforward jobs like this can
their complications.

## OSSIBLE POSITION

n the other hand the customer
not very clear as to when he
d spare the car. He wanted it
the weekend, there was an im-
ant business appointment out of
n on the Monday, and so on,
we seemed to be getting no-
re.

nally I suggested that I could
ably do a quicker job for him
e felt disposed to take the set
himself and leave it at the shop.
he agreed to do and seemed
ave enough idea of where things
e to be able to handle it.
us it was that, a couple of days
, the set was pushed across the
nter and I set about determining
ther my diagnosis was correct
o. First problem was to work
the connections to the set and
it working. Apart from the
al they all appeared to be made
ugh an octal plug and these had
e sorted out and identified.
hen this was done and the set
lly working I was gratified to
rve that it still exhibited the
e symptoms. I was even more
ified when I managed to wangle
ew electrolytic into position
ss the HT line and found that
mediately cleared the trouble.
ell, at least that was one snap
nosis that was correct.
was fairly obvious that the set
the electrolytics were a few
s old and that the electrolytics
simply died of old age. I, there-
changed both of them, even
gh the set seemed to perform
enough with only one new one.
r all, the cost of the component
small compared with the cost
dismantling the set and re-
mbling it and was a worth-
e insurance.

## GNMENT

ter that it was simply a matter
general routine check and align-
t and handing it back to the
mer, not forgetting to point out
my original assumption regard-
the trouble had been correct.
l of which may sound somewhat
ne and you may be wondering
I have taken the trouble to
ll such an apparently ordinary
as a couple of faulty electro-
s in a car radio.

The really interesting part of the story, I think, is the symptoms which the set exhibited—and why.

The whole condition may perhaps be best described as a form of low (audio) frequency instability involving almost the entire receiver. This may appear something of a contradiction, since the front end of a set will not normally respond to audio frequencies. This is partly true, but we must consider what happens when a carrier is present in the front end.

Assuming for the moment that a carrier is present, let us see what can happen when the power supply is in poor shape. Due to the failure of the electrolytics, particularly the second one, the regulation from the supply is poor. As a result, any change in current drain will cause a change in HT voltage, the speed at which this change can take place depending on the amount of effective capacitance left in the circuit.

Under these conditions any change in HT current due to a signal appearing on the grid of the output valve will be felt by every stage of the receiver, by reason of the altered HT voltage. The section most vulnerable to such changes is the local oscillator section of the converter, which can shift frequency quite appreciably when the HT voltage changes.

This rate of change will be at an audio frequency, resulting in a change of frequency in the IF channel at this same audio frequency. This crude form of FM is something the IF channel cannot handle without causing a decrease in signal strength as the signal deviates from normal.

## AUDIO PULSE

Thus the signal is not only passed through the front end of the set by reason of the carrier but it finally presents itself to the audio channel as an audio pulse. Once again this affects the HT current drain, the HT voltage, and the oscillator frequency.

And so we have a form of audio feedback capable of operating over most of the set, at any rate from the converter onwards. Hence the instability which only occurred when a carrier was present. It also accounted for the rather hollow characteristic accompanying the noise level, being simply a near-unstable condition which couldn't quite make it.

The condition is similar to that which sometimes occurs in short-wave sets and which results in howling or motor-boating when a strong carrier is tuned in. Referred to as "oscillator flutter" it is due to the same thing—small changes in HT voltage causing oscillator shift. This causes a change in signal strength, another change in HT voltage, and so on.

At the higher frequencies most oscillator valves are much more prone to shift with changing plate voltage, so that the condition of oscillator flutter can quite easily occur even when all the components are functioning correctly, being more a question of the set's design.

## SEPARATE BYPASS

To avoid this condition it is often necessary to give the oscillator plate circuit an electrolytic all to itself. In conjunction with some decoupling resistance this is normally sufficient to hold the oscillator plate voltage steady over a wide range of circuit conditions.

Another similar effect, which most of us have encountered at some time, also occurs in short-wave receivers but is due to quite a different cause. In this case the oscillator is detuned, not by the changes in voltage, but by mechanical vibration in the tuning gang. This is caused by sound from the speaker and is often aggravated by flimsy cabinet construction.

It can also be due to a faulty gang, the usual trouble being a plate which is not firmly anchored to the main shaft or fixed supports.

Even without faulty components this problem can sometimes be serious, and is one reason for the mounting of the short-wave deck on rubber bushings.

Perhaps acoustic feedback in short-wave receivers is a long way from the original theme of faulty electrolytics in a car radio but, in reality, there is a common factor. This is the ability of a set to pass an audio frequency impulse through the front end when a carrier is present. If this point is appreciated

**(Continued on Page 121)**


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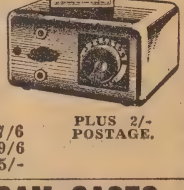

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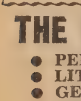

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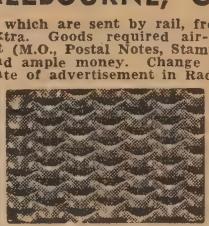

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## EVERYTHING FOR THE RADIO AND ELECTRICAL EXPERIMENTER

# GETTING YOUR AMATEUR LICENCE

**he commonest form of FM modulator is the reactance valve, so called because it is able to imulate a variable inductor or capacitor connected across an oscillator or amplifier circuit. This article explains how it operates.**

VING examined the general principles of FM and PM, we now consider the circuits which used to obtain them in practice. s most unlikely that you will sked in an AOCP examination o more than produce elementary its of FM modulators, so we confine the discussion here to standard methods which are, in included in most handbooks the subject.

e have already seen that FM btained by causing the oscillator uit of a transmitter to vary its uency in direct proportion to the litude of the modulating fre- ncy. In other words, loud signals greater modulation or frequency iation than weak signals.

## DEPENDENT OF FREQUENCY

he amount of deviation or mod- tion is not affected by a change the audio frequency of the dulating signal. In other words, igh and a low audio frequency bring about the same amount deviation if they pass through modulator at the same amplitude. hese are the conditions the FM dulator must bring about.

ow the frequency determining ors in a self-excited oscillator uit are the inductance of the ing coil, usually in the grid cir-, and the capacitance value of condenser which tunes it.

we wish to alter the resonant quency of the circuit, we can do by changing either the capacit- e of the condenser or the induct- e of the coil.

the circuit were tuned with a denser, which is the normal thing,

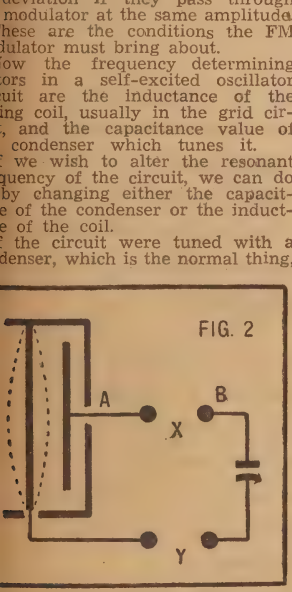


FIG. 2

we were to couple its shaft to otor which altered the condenser ing by a very small amount and k again 100 times per second, we ld be frequency modulating the llator at the rate of 100 cycles second (equivalent to a very audio tone), and the amount dulation or deviation would be al to the amount by which the denser movement altered the ng.

or the purposes of discussion, let us assume we started off with an oscillator frequency of 7000 Kc, and the movement of the condenser changed the frequency down to 6995 Kc, back to 7000 Kc, up to 7005 Kc and back again to 7000, at the rate of 100 times per second.

The oscillator would then be modulated at 100 cycles, with a deviation, plus and minus, of 5 Kc.

The general arrangement is shown in Fig. 1, in simplified form. Each rotation of the motor moves the condenser shaft up and down by a fixed amount, thus altering its capacitance.

Note that it isn't the speed with which the condenser moves which

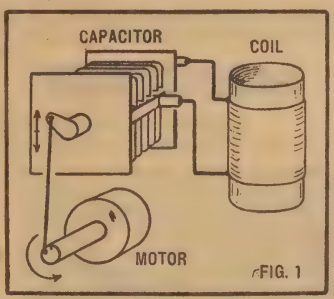


FIG. 1

controls the variation in frequency. It is only the amount of movement which does this, so that the frequency deviation is not dependent in any way on the rate at which the capacitance varies in value.

If we were to couple the motor to an iron slug in the coil, so that instead of causing variations in capacitance we varied the inductance, the general effect as far as FM is concerned would be the same.

Such methods of obtaining FM aren't normally used for transmission, although they could be for special purposes, and are sometimes encountered in signal generators used for observing the band-pass curves of tuned circuits. When linked with the time base of an oscillograph, they enable the tube to trace out the selectivity curve directly on the screen, both the amount of deviation and its frequency being adjustable in many cases.

## BETTER METHODS

But this method isn't very useful when we wish to transmit speech. Some other means of changing the capacitance or inductance of the tuned circuit is needed, one which will operate directly from sound or voice waves.

Suppose we connected a condenser microphone across the tuned circuit of the oscillator, and fed sound waves into it. What would happen?

A condenser microphone consists essentially of two metal plates spaced very close together, so that, when struck by sound waves, one of them is free to vibrate. In doing so it changes the spacing between itself and the second or back plate, the rate of change being proportional to the frequency, and the amount of change being proportional to the strength or amplitude of the sound waves which strike it.

In other words, if we project a 100 cycle audio tone from a loud speaker toward the microphone, its diaphragm will move at the rate of 100 vibrations per second, moving only slightly for soft tones, but more violently for loud tones.

If we were to measure the change in capacitance of the microphone under these conditions, we would obviously find that it would become greater as the moving plate moved nearer to the back plate, and smaller as it moved away from the back plate. The amount of capacitance change would be greatest for the loud tones, because the movement of the diaphragm would also be greatest.

The number of times per second the change from minimum to maximum capacitance took place would be 100 per second, the frequency of the sound we were using.

## ILLUSTRATION

Fig. 2 illustrates this point. Fig. 2A is an idealised cross-section of a condenser microphone. The dotted lines represent the extent of the diaphragm movement as it vibrates, thus changing the capacitance between the two plates. Fig. 2B shows the microphone in circuit symbols as a variable condenser, with the diaphragm the moving plate. The connecting points in each case are at X and Y.

Now have a look at Fig. 3. Here we have connected the condenser microphone directly across the tuned circuit of an oscillator valve, the frequency of which is normally set by the values of L, the coil, and C1, the tuning condenser.

But as the microphone is also a small condenser, of value C2, the frequency is here determined by the value of L and the values of C1 and C2 in parallel.

It is obvious now that, if we

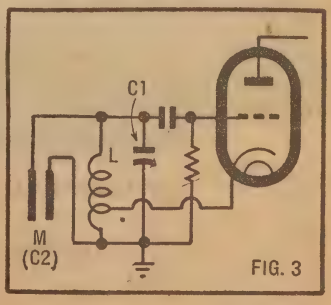
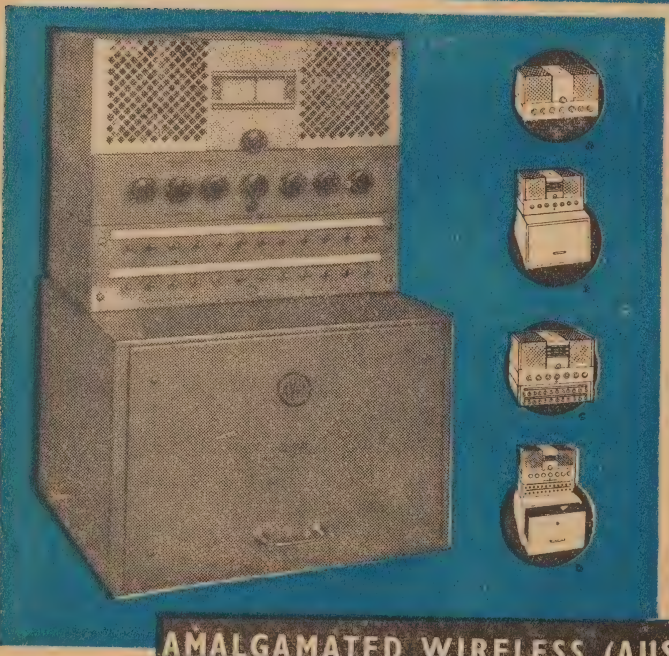


FIG. 3

# FOREMOST IN SOUND

## ADDRESS, RADIO AND RECORD PLAYING SYSTEMS

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s into the microphone, the value
2 will increase and decrease by
nall amount determined by the
itude of our voice frequencies,
the resonant frequency of the
it will vary in step. Thus we
obtained a very simple form
requency modulation.
though this method would work,
not used in modern circuits for
reasons. There are much better
of obtaining FM.
e most popular of these is the
tance valve method. This is a
al receiving type, generally a
ode, which is connected across
oscillator circuit in much the
way as the condenser micro-
e. The circuit with which it
sed operates so that the valve
ars to the oscillator circuit as
r a variable inductance or a
able capacitance, depending on
the components are arranged.

## PORTIONAL TO GM

he amount of inductance or capa-
ce represented by the valve is
rsely proportional to its mutual
ductance, or Gm. Thus, if we
nge for the Gm. to vary with
voltage impressed on the grid
he valve, we will alter either the
tive inductance or the effective
acitance of the oscillator circuit
which it is connected, and thus
in our FM.
ow, the Gm of a valve is deter-
ed by its plate current, and this
of course, be readily controlled
adjusting the voltage applied to
control grid. If, therefore, we
nect the microphone circuit to
grid of the reactance valve, the
o voltages it provides will swing
grid alternately positive or nega-
in the normal way, the plate
ent being greatest on the posi-
peaks and least on the negative
ks. The grid bias of the valve is
to the appropriate value.
effect, therefore, we have an
ctance or a capacitance, repre-
ed by the modulator, the value
which can be varied in value by
sound waves impressed on the
rophone. The frequency of the
llator will be varied in step
as it did in the case of the
denser microphone. This is ob-
sly a much better way to obtain
for the whole thing can be
nged as a compact little unit
no direct connection between
oscillator circuit and the micro-
ne itself.

## ICAL CIRCUIT

ig. 4 shows the essential com-
ents of a reactance modulator
FM.
he oscillator valve is V2, shown
e as a simple triode with L and
forming the tuned circuit.
onnected across this circuit we
e the reactance modulator valve
with C3 a plate blocking con-
ser and an RF choke to feed high
ion to the modulator plate. The
ulator is otherwise connected as
ordinary voltage amplifier.
he components which determine
operation as a reactance valve
the resistance R between the
e and the grid, and the dotted
acitor C1, which is a very small
ue generally represented by the
to cathode capacitance of the
ve itself. The RF choke in the
circuit isolates the input cir-
from RF currents, and it is
eral practice to feed the grid

circuit from a pre-amplifier which isolates the microphone circuit still further from the RF end of the circuit, and provides appropriate gain.

The next step is to consider how the valve is made to operate as an inductance or a capacitance connected across the oscillator circuit.

This takes us into a disussion of voltage and current phase relationships and it must be assumed that the reader is familiar with these as they apply to capacitance, inductance, and tuned circuits.

The frequency of the oscillator circuit is determined by the electrical constants associated with it. In Fig. 4, these can be considered as being in two parts, those associated with V2, the oscillator valve, and those contributed by V1.

We see by examination that the

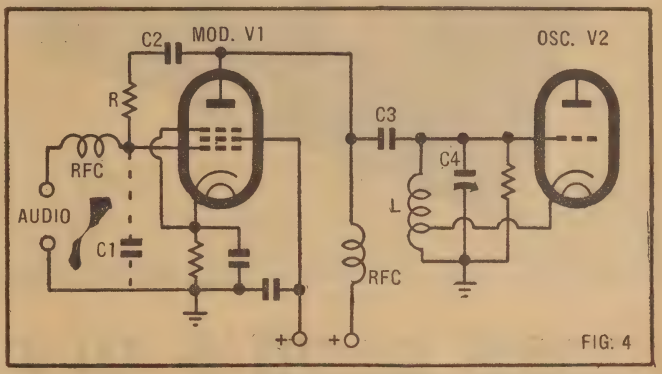


FIG. 4

plate circuit of V1 is connected directly across the oscillator tuned circuit. A portion of the voltage appearing at the "hot" end of this circuit is fed back to the grid of V1 through a voltage divider consisting of resistor R and a small capacitance C1. This, as already mentioned, may be in practice the input capacitance of the valve, as only a small value is needed having a reactance much smaller than the value of resistance R.

Naturally, RF currents will flow through this divider circuit. Because R is a pure resistance, it does not affect the phase of either the voltage or the current in this part of the circuit.

But this is not true of the condenser C1, which, because of its capacitance reactance, will cause the RF voltage to lag behind the RF current by 90 degrees, after the manner of condensers. This phase relationship is therefore established at the grid, because the condenser C1 forms an impedance between it and earth.

## OPPOSITE PHASE

Now the grid and plate circuits of a valve are in opposite phase relationship, because an increase in voltage at the grid will cause an increase in plate current but a decrease in instantaneous plate voltage, and vice versa. The phase shift between the two elements is equal to 180 degrees.

This means that the phase relationships at the plate of V1 will be opposite to those at the grid circuit, and as we have already established that the voltage is lagging the current by 90 degrees at the grid, it follows that the current will be lagging the voltage at the plate by a similar amount.

Now by reference to elementary theory, we know that this phase relationship between voltage and current is characteristic of an inductance in electrical circuits. Thus, because of its electrical similarity, V1 appears as an inductance in parallel with the tuned circuit of the oscillator.

This explains why a valve which doesn't look in the least like an inductance in physical fact can be made to assume the characteristics of an inductance by means of the phase-shifting network R and C1.

It will be fairly obvious now that if the grid voltage of V1 is varied, the plate current and voltage will be varied also, and the phase shift in the plate circuit will be impressed on the tuned circuit of the oscillator, of which the plate circuit of V1 is a part.

And if the grid voltage applied to V1 varies at an audio rate, as it will if the output of a microphone pre-amplifier circuit is fed to it, there will be a corresponding phase shift at an audio rate impressed upon the oscillator circuit.

This phase shift will change the oscillator frequency about its mean value to give a deviation proportional to the amount of phase shift, and so we have our FM.

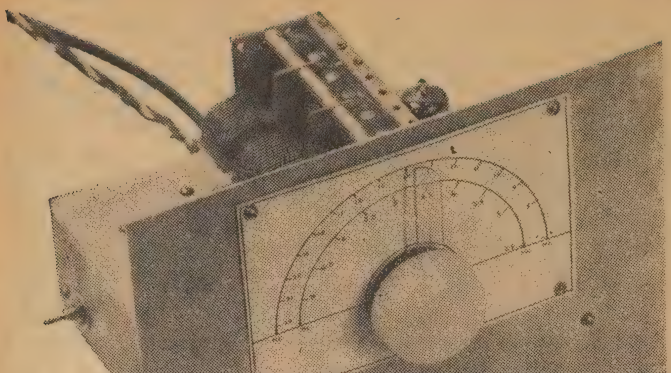
## VARIABLE REACTANCE

Another way of explaining the process is to say that the inductive reactance of the circuit is increased and decreased when audio is supplied to the modulator grid, and, of course, increasing and decreasing the circuit inductance will increase and decrease the frequency of the oscillator circuit.

Without going into a detailed circuit analysis, it can be shown that if we interchange the position of C and R in the circuit, using a larger value of C and a smaller value of R, the phase relationships will be reversed, and V1 will now appear as a capacitance across the oscillator circuit instead of an inductance.

The net result as far as obtaining FM is concerned is the same, and the choice of circuits becomes a matter for convenience in the design of the modulator circuit. The new arrangement is equivalent to changing the capacitive reactance of

**(Continued on Page 87)**



The front view of the converter is similar to that of the single band design described last month. The dial is based on a planetary drive using a home made pointer and calibrated scale.

thing is much simpler than it m
appear.

In an effort to keep the unit
small and efficient as practicab
we have packed things in fai
tightly. One immediate advanta
is that there are no extra long le
which, at these frequencies, co
easily cause instability.

RF stages are particularly pr
to this kind of trouble. Even
small amount of capacitance
tween plate and grid leads can ca
the RF valve to act as a tuned pl
tuned-grid oscillator. Careful se
ration of the leads is importa
in the single band job. It is ev
more important, when another ba
is added to the converter, due
additional stray capacitance int
duced by the switch and wiring.

## EARTHING

Earthing is also a very impo
ant point in this respect and
have modified the original layo
in order to ensure stable operati
within both bands.

We discussed the circuit of t
converter in detail last month a
we can well concentrate now
constructional problems.

As mentioned earlier, room w
left for the additional compone
on the original single-band chass
which measured 6 x 6 x 2in. If y
want to extend the coverage of
converter already in operation, y
will need to remove the coils
order to get the additional wiri
and components into place. Wh

# A TWO BAND S-W CONVERTE

**In our last month's issue we described a single band converter covering the 13-40 metre band. This article tells you how to obtain additional coverage with the converter, by adding another set of coils to cover the 40-110 metre band. This band offers many interesting programs from Africa and South America as well as additional channels from the Continent.**

IN most cases overseas stations transmit in more than one band to make sure that unfavorable local reception conditions do not prejudice reception of the transmissions. While conditions may be very bad in one band, satisfactory signals can usually be received in another. It is very useful, therefore, to have as wide a coverage as possible on S/W receivers.

The region below 13 metres does not readily lend itself to long-range broadcasting and, in any case, satisfactory reception cannot usually be obtained with conventional circuits at these frequencies. The sensible thing to do, therefore, is to extend the coverage to the lower frequencies, or longer wavelengths, taking in the 40-110 metre band.

## READILY ADAPTABLE

The circuit given in the previous issue is readily adaptable to this band, and it only requires the addition of another set of coils and a wave-change switch.

In fact, we made provision in the original chassis design for the additional components to be fitted. Depending on your requirements, you can build the converter for single-band coverage only and leave it at that or add the second band later, or provide for two-band coverage right from the start.

The circuit is basically the same as published last month, being similar to the front end of a short-wave receiver, with a 6BA6 RF stage and a 6AE8 converter. However, provision for band switching has been made, and this makes the circuit look rather complicated. Don't let this deter you from building it, though. You will find that everything will fall naturally into place, and, in practice, the whole

by L. Varady

on the job it would be well wort
while to check on the position
components already installed.

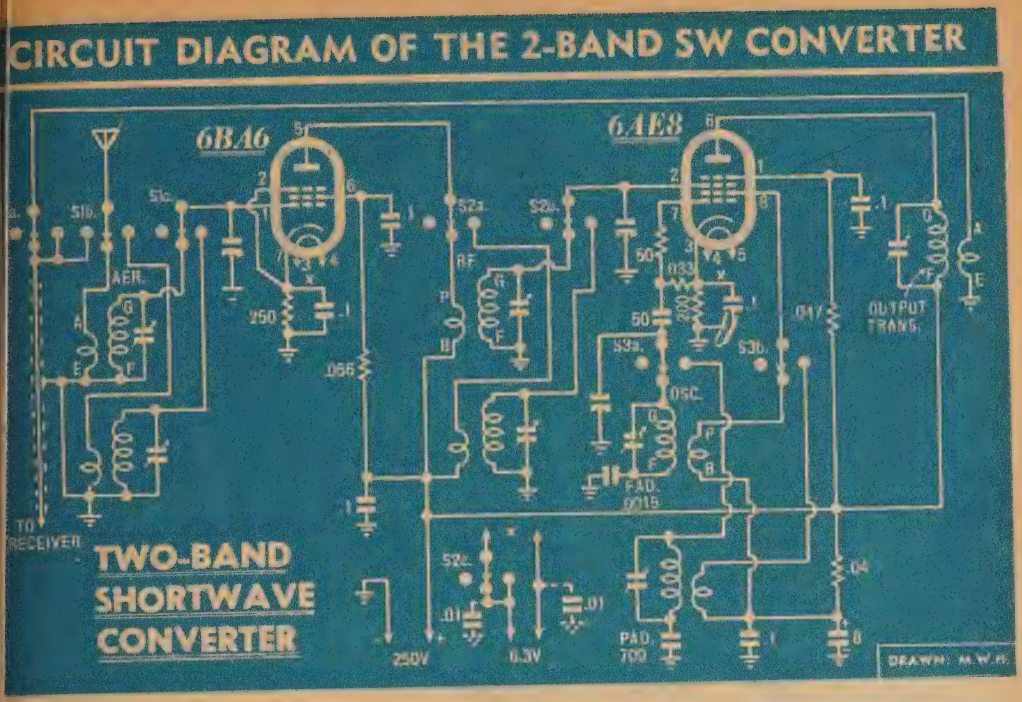
There was room to spare in t
single-band converter, but the a
dition of extra trimmers, coils a
the switch may make it necessa
to move some of the original co
ponents.

## TWO STAGES

We wired the converter in t
stages, and to assist you with t
construction we have shown the fi
stage in the picture on top of t
following page.

Due to the compact layout the
is very little leeway in the plac
ment of components. Most of t
parts can go in one way and o
way only.

First of all we placed a 16 g ti
ned copper busbar between the ear
terminal and the 6BA6 socket a
a similar busbar between the t
rear mounting screws of the tuni
gang. This provided a comm
earthing point for the RF and aer
trimmers on one side and the osc
lator trimmers on the other. T




The circuit diagram shows the wiring of the individual coils and their switching.

trimmers are mounted in such a way that the earthed plate (top plate) connection is nearest the busbar.

The busbars were extended into the corners of the chassis near the valve sockets as an earth return for the cathode resistors and bypass capacitors. The front and rear gang wipers were also connected to the respective busbars.

Two tagstrips in the rear left hand corner support the screen and the oscillator decoupling resistors. Twisted leads take the HT supply from here to the respective connections on the valve pins and the oscillator coils.

## BYPASS PLACEMENT

These leads should be at earth potential as far as RF is concerned, and the bypass and decoupling capacitors were therefore placed as near as possible to the valve and coil connections.

Filament wiring, cathode resistors and bypass capacitors should also be placed into position at this stage. You will notice that the leads to the filament switch are brought out to the centre of the chassis for connection to the RF section of the switch when the latter is put into place.

Although not shown in the photograph, the oscillator grid resistor and capacitor should also be installed before the coils and the switch.

The output transformer and its trimmer and the connection of the supply leads completes this first stage, or layer, of construction.

Commercial coils wound on ½in iron-cored formers are available for both bands and they can easily be adapted for use in the converter. We used them in the prototype with quite good results, although some modification of the oscillator coils is necessary owing to the higher intermediate frequency used.

These modifications are best carried out before the coils are installed. For the 13-40 Meter band quarter turn will have to be removed from the grid end of the secondary and two turns from the plate end of the feedback winding. For the 40-110 meter band three turns from the grid end of the secondary only will have to be removed.

This much done the remaining components can be added, including the coils, switch and associated wiring. Put the coils in first and complete as much of the wiring to them as you can.

Attach short leads to the coil and gang terminals at this stage also ready for connection to the switch. Starting at the front of the chassis you can see the aerial, RF and oscillator coils in the photograph.

In order to prevent coupling between the coils we have staggered them, mounting the aerial and oscillator coils for each band on one side of the chassis and the RF coil on the other. Physical separation of coils in this way is sufficient to eliminate the need for individual shields. The arrangement can be seen quite clearly in the photograph.

A 3-position, 3-section 3-pole Oak type switch serves as a wave-change

## PARTS LIST

1 chassis 6 x 6 x 2in.
1 panel 6 x 8in.
1 3-gang tuning capacitor, min. MSP, AWA or similar.
2 valves, 6BA6 and 6AE8.
1 min. vernier drive (Jabel).
1 switch, 3 pos., 3-section, 3-pole with 2in spacing.
1 set of 13-40m S/W coils, Aerial, RF, Oscillator.
1 set of 40-110m coils, Aerial, RF, Oscillator.
1 min. B/C aerial coil.
7 trimmers, 5-50 pf, flat chassis mounting.
2 valve sockets, 19-pin, 1 7-pin min.
2 spring terminals.

### CAPACITORS

4 .1 mfd 400v paper, 2 .1 mfd 200v paper, 1 8 mfd 350V electrolytic, 1 50 pf mica. 1 .0015 mfd padder, 1 700 pf padder (see text)

### RESISTORS

1 .056 meg, 1 .047 meg, 1 .04 meg, 1 250 ohm 1 200 ohm, all 1 W. 1 .033 meg, 1 50 ohm all ½ W.

### SUNDRIES

Screws, nuts, solder, solder lugs, tinned copper wire, hookup wire, shielded hookup wire coax or microphone cable, 3 lug tag strip, 4-lug tag strip, spaghetti, 2 knobs, perspex, and cardboard for dial.

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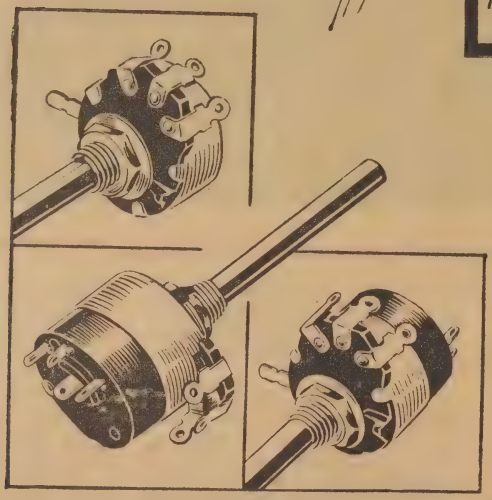

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tch in the present design. As no tches of this type are available h just the right wafer spacing, will have to shorten a commerly available switch with 2in spac-. This process is quite easy and re are no special tricks to it.

Dismantle the switch and cut the ft to 4in from the clicker plate. e tubular spacers will need to be to 1 5/8in and two of them, thus rtened, cut in half to allow a eld to be fitted between the first d second wafers of the switch.

The switch is then reassembled th a tinplate shield 2¾ x 1½in inted in the position indicated on photo, and the surplus length of sembly rods clipped off.

This shield, which separates the id and plate circuits of the RF ge, should ideally be soldered to e busbar running near the front the chassis. As aluminium cannot soldered with ordinary equipent, it will be necessary to make is shield of metal which can be sily soldered. Tinplate, sheet brass copper would be suitable.

## HORT LEADS

When the switch is put into place, re should be taken to bring one mmon contact on each wafer in ne with the gang connections thus nsuring short leads for critical conections. Check on this point before ne shield is soldered into place.

We suggest that 18-gauge wire be sed for connecting the coil terinals to the switch and wires arrying the full HT should be overed with spaghetti. These preautions make for general rigidity nd also provide a safeguard against ccidental shorts.

The output leads could be put into lace at this stage. Two positions of he switch are occupied by the two ands and the third one connects he aerial to the output lead. This hangeover is affected on the first wafer of the switch and consequently he output transformer will have to e connected to this wafer.

We used ordinary shielded hookup wire covered with spaghetti rather than coaxial cable, because the latter would be very hard to bend and fit into the available space.

Coaxial cable, however connects the converter to the main receiver, although high grade microphone cable could be used equally well. The shielding of this cable is soldered to the shield between the first two sections of the switch, the core being connected to the appropriate switch contact.

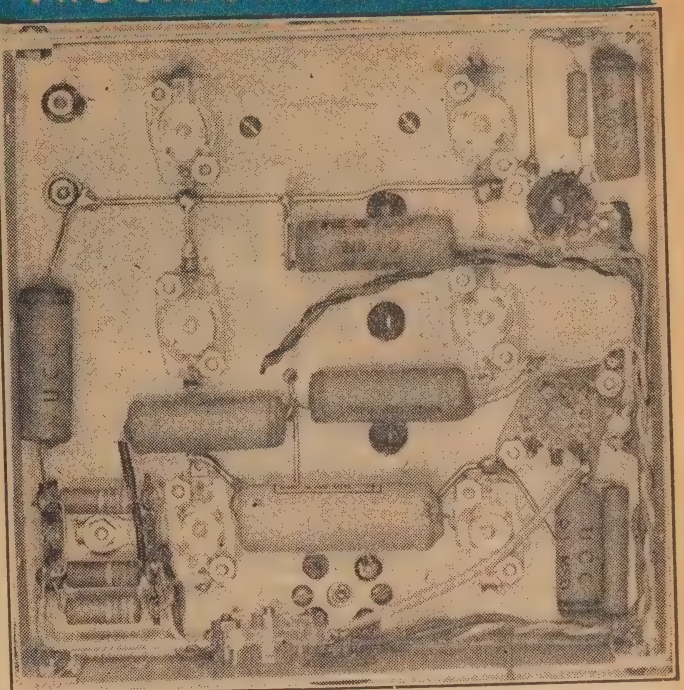
## OUTPUT CABLE

As indicated in the photograph, the output cable is brought to the edge of the chassis and fixed to it near the coil bases by two small aluminium clips. It would be wise to cover the cable with some tape where it passes through these clips to prevent them from cutting through the outer sheathing.

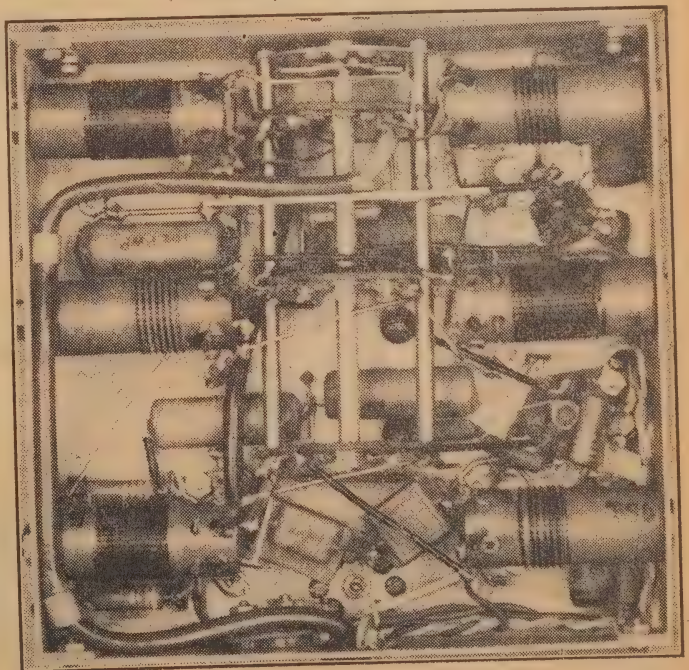
A minor problem presented itself when we were about to connect the padders. For an intermediate frequency of 455 Kc, for which the oscillator coils were originally intended, padder values were specified which can be obtained easily in close tolerance standard capacitors, namely, .002 and .005 mfd for the 40-110 and 13-40 meter coils respectively.

However these values are not suitable with the higher intermediate frequency, 1600 Kc, even with the reduced number of turns on the

# TWO STEPS IN CONSTRUCTION



This picture was taken during construction and shows valve sockets, trimmers, and some small parts mounted in place before the coils are connected. The condenser at the extreme left was relocated near the centre coil as shown in the picture below, otherwise no positional changes were made.



Here is the same chassis after the coils and switch have been added and wired up.

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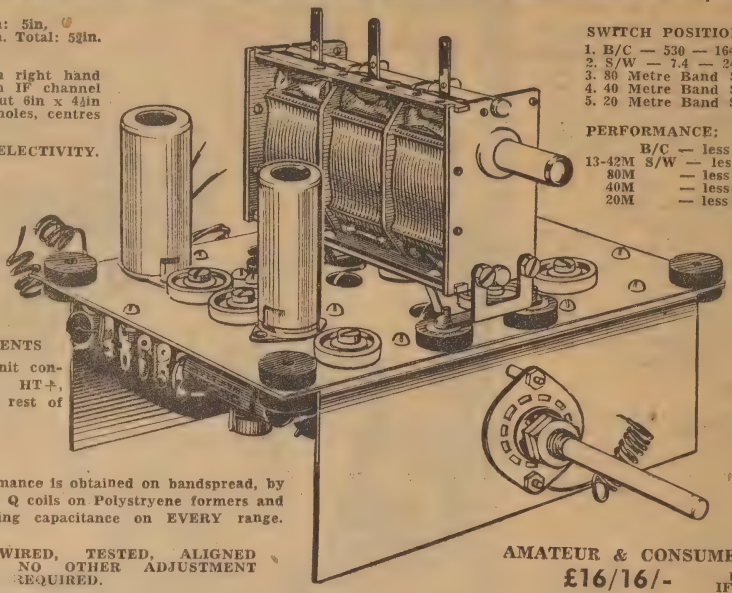
Length: 7¼in. Depth: 5in,
Height—Chassis: 2½in. Total: 5¾in.

**MOUNTING:**
Unit is mounted on right hand side of chassis with IF channel along back. A cut-out 6in x 4¼in is required with 4 holes, centres 4¾in x 6¾in apart.

**IF CHANNEL. HI-SELECTIVITY.**
2 stages: "Q+"
IF 25's + 26.
NORMAL
HI GAIN
1 stage: "Q+"
IF 8 + 9.

**POWER REQUIREMENTS**
All pigtails from unit connected directly to HT+, Fils, Earth, etc; to rest of receiver.



**SWITCH POSITIONS:**
1. B/C — 530 — 1640 Kc/s.
2. S/W — 7.4 — 24 M/cs.
3. 80 Metre Band Spread.
4. 40 Metre Band Spread.
5. 20 Metre Band Spread.

**PERFORMANCE:**

| | |
|---|---|
| B/C | — less than 1uV. |
| 13-42M S/W | — less than 4uV. |
| 80M | — less than 2uV. |
| 40M | — less than 3uV. |
| 20M | — less than 2uV. |

**VALVE TYPE**
Unit requires addition of:
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1—6AE8 Converter

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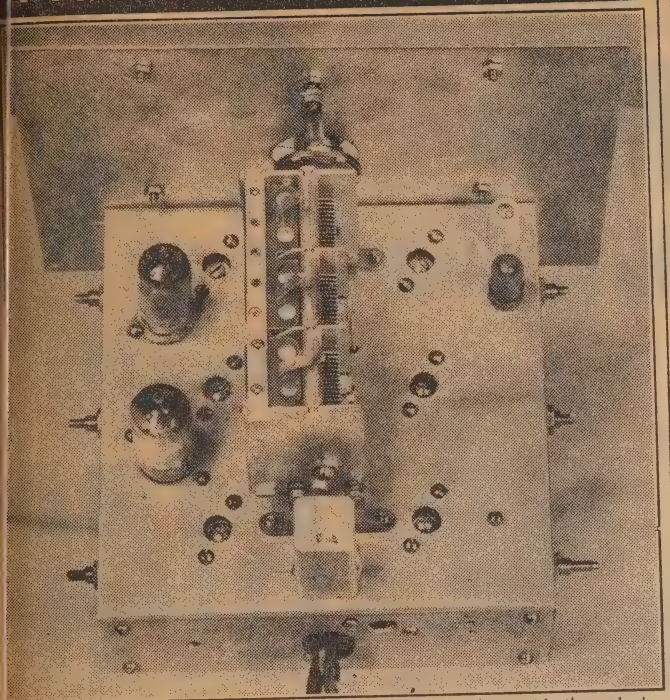
## A TOP VIEW OF THE CONVERTER



This picure shows the three gang condenser mounted in place, with the output coupling coil immediately behind it. The two sets of three trimmers are arranged each side of the gang and adjusted through holes in the chassis. The iron core adjusting screws for the tuning coils may be seen projecting from each side of the chassis.

oils. The values for this IF were etermined experimentally and came o 700 pf and .0015 mfd respectively. These padders ensure the best track- ng possible at the intermediate fre- quency specified.

However these values are not generally available in close toler- ances, although they are fairly critical. For the home constructor therefore, it would be wise to select capacitors which have the required value, or, alternatively, to make up the required value from several smaller close-tolerance capacitors.

### VARIABLE PADDER

It would be possible, of course, to include a variable trimmer or padder as part of the value and adjust this for optimum tracking over the band.

The padders are mounted above the oscillator decoupling electrolytic right next to the coil terminals. As there is no handy earth connection for these it is wise to solder a stiff piece of copper wire between the main earth busbar and a solder lug on the rear of the chassis and anchor them to this wire.

That is about as much as needs be said about the construction of the converter. Before going over to calibration procedure, however, it may be an advantage to mention some points about the dial mechanism used.

In last month's single-band converter we mentioned the use of a recently released small planetary drive which we have found very useful for such an application.

There are at present two versions of this drive, both of which can be used in this unit. We mention this because the two types require different approach as far as the pointer is concerned.

On one type, described last month, there is an extended slow-moving collar, which can be utilised for the attachment of the pointer. The pointer is made from a thin strip of aluminium, bent into a loop at the bottom and tightened on the collar with a small bolt and nut.

The other type is provided with a small detachable collar, to which a different type of pointer can be fixed. As a matter for the record, we have used this second type on the present converter, making the pointer from a piece of 3/32in celluloid, offset to one side of the reference edge.

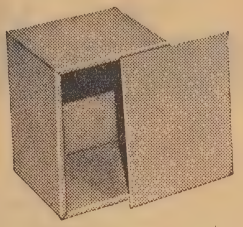
This can be attached to the collar, which has three small fixing screws for this purpose and mounts on the shaft by means of grub screws. It is a matter for individual preference which type of pointer you use.

### HAND CALIBRATED

A hand-calibrated cardboard dial was used, as there are no suitable dials available at present. After the dial has been calibrated it could be protected from wear and tear by a perspex sheet screwed over it. Be sure to allow for this when cutting the drive shaft.

The alignment procedure is the same as for an ordinary superhet


# METAL UTILITY CABINETS



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| MC67 | 6in | 7in | 12in | 13 9 |
| MC81 | 8in | 10in | 10in | 17 0 |
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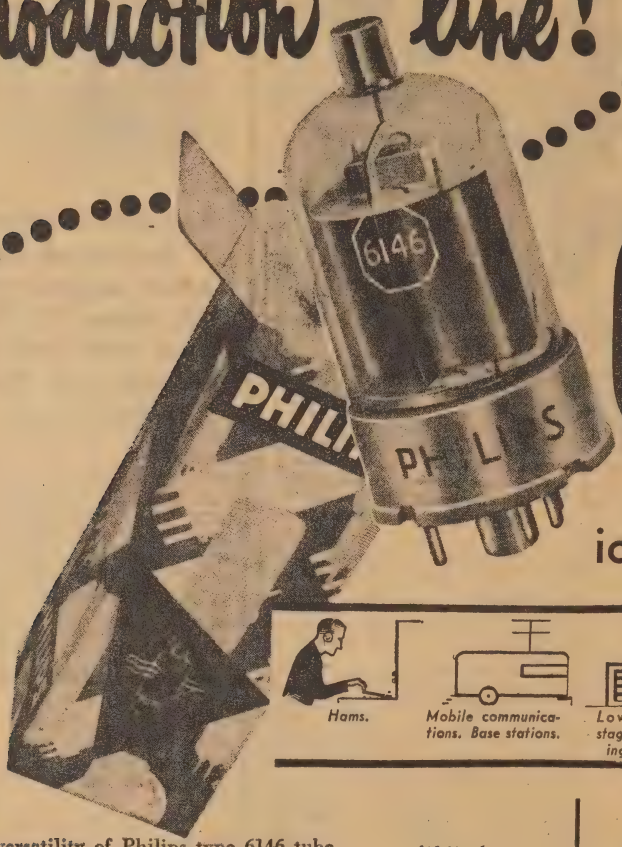


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PV6.5

h an RF stage. Before attempting
align the converter, though, it
uld be wise to mark the trimmers
t cores belonging to the one band
h a suitable letter or colored dot.
is all too easy to upset the align-
nt of one band, whilst attending
the other one. Of course if you
summon enough concentration
ile aligning the unit, this pre-
ition would not be required.
first step is to tune the main
eiver to a spot in the band where
strong stations are apparent. You
ll usually find such a spot at or
ar 1600 Kc — right at the extreme
d of the band.
Then, with the converter switched
one or other of the short-wave
nds, and feeding into the receiver,
just the converter output trimmer
a peak in background noise. The
mmer need not be touched again,
ovided the main set is always
ned to the same spot on the dial.

## ILL HIGH TENSION

Care should be used when adjust-
g the trimmer provided, as this
rries the full high tension.
If you have a signal generator at
ur disposal it would be advisable
use it to align the signal circuits
this provides a quick and easy
eans of calibration. Otherwise the
rial and RF trimmers and cores
ould be adjusted for correct track-
g and highest sensitivity, and the
ale calibrated when some stations
ave been positively identified.
Remember the "golden rule" of
ignment: Peak the cores only on
e low frequency end of the band
nd the trimmers only on the high
equency end.
With the coils specified, the cover-
ge should be approximately 2.5 to
.5 Mc, and down from 7 to 22.3 Mc.
hould it become evident, after the
dentification of some stations, that
e coverage extends either above or
elow these frequencies, the oscil-
ator cores and trimmers can be
djusted to put things right.
The converter is capable of excel-
ent results if correctly aligned.
Whilst being tested in our workshop
t brought in several overseas stat-
ons through all the hazards of mid-
ity interference. In a good location,
here were literally hundreds of
hone and morse signals to choose
rom.

## PERFORMANCE

As mentioned before, the ultimate
performance will also depend on the
ype of receiver used in conjunction
with the converter. Quite obviously
a good aerial system and a receiver
which incorporates an RF stage and
probably an audio stage as well, will
yield much better results than a four
valve mantel set.
If you wish to wind your own
coils for the low frequency band,
here are the data:
Aerial: 8 t. primary, 19 t. second-
ary.
RF: 13 t. primary, 19 t. secondary.
Primaries 35 g. SWG, secondaries
24 g. B & S, close wound, 1-16in
spacing between windings. Primaries
are wound below the earthy ends of
secondaries.
Oscillator: 8 t. plate winding
below padder end of 14½ t. grid
winding, no spacing, close wound,
plate winding 35 g. SWG, grid wind-
ing 24 g. B & S. Plate and grid
connections are at opposite ends of
former.
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grooved.


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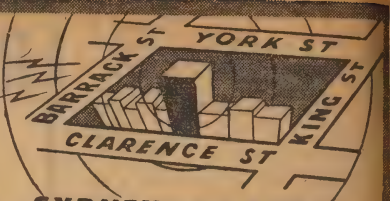


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# MODERN VHF DOUBLE TETRODES

**As radio communication moves down to the higher frequencies for an increasing number of services, greater emphasis is placed upon valve design. This article, while specially referring to Mullard valves, covers many problems, the solutions to which are typical of modern design in general. The valves of today operate efficiently under conditions which were unheard of a few years ago.**

THE well-known advantages of screen-grid valves for high frequency amplification has led to the widespread use of tetrode valves in radio transmitters. In order to preserve the good performance of tetrodes at very high and ultra high frequencies, special types of construction are necessary. Some recent double tetrodes, incorporating such features as internal neutralising, operate efficiently at frequencies as high as 600 Mc/s.

The design of transmitting valves for use at frequencies above 150 Mc/s presents a number of problems. Stray capacitances and inductances inside the valve envelope affect operation more and more as the working frequency is raised. Despite these difficulties, a special construction now used in Mullard double beam tetrodes makes possible efficient operation at frequencies up to 600 Mc/s.

For high frequency operation, the screen grid valve has the very important advantage over the triode that the anode-grid capacitance can be made very small. In a typical case it may be a hundred times smaller than in a tetrode or pentode than in a triode of comparable ratings. In high frequency transmitters, tetrodes and pentodes may, therefore, be operated in conventional circuits without neutralisation.

As the working frequency is increased, however, the effect of stray inductance in the screen and cathode circuits becomes marked. Inductance in series with the cathode gives rise to degenerative feedback which results in a lowering of the valve input impedance. This causes a waste of drive power. Inductance in series with the screen grid can give rise to positive feedback which may result in instability. Even when the effective length of the screen and cathode leads is made as small as possible by the use of short-lead decoupling capacitors connected at the valve socket, the self-inductance of the internal cathode and screen leads remains, and this is sufficient to cause losses and instability at very high frequencies.

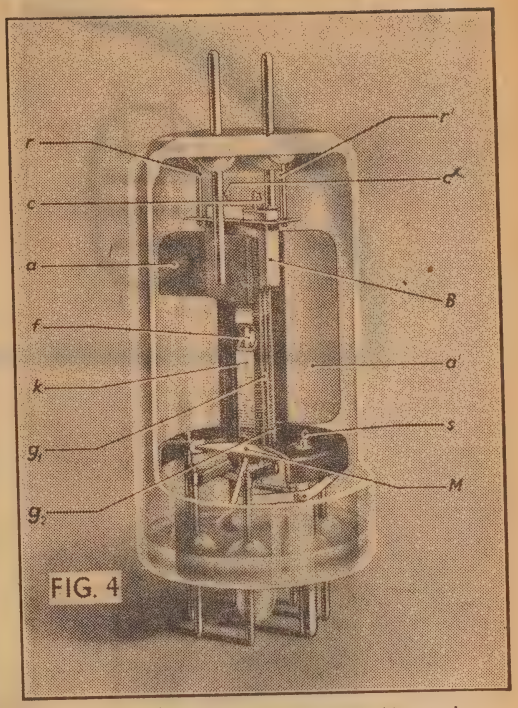


FIG. 4

Cut-away view of a Mullard V.H.F. double tetrode.

| | | | |
|---|---|---|---|
| r. r' | Electrode support rods. | a, a' | Anodes. |
| c, c' | Neutralising capacitors. | B | Beam plate. |
| M. | Mica electrode supporting plate. | | |
| k. | Cathode. | g2 | Screen grid. |
| g1 | Control grid. | S | Internal screen. |

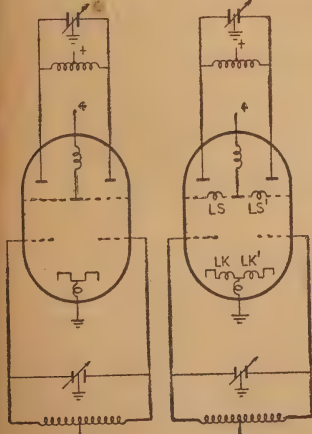


FIG 1.



FIG 2.

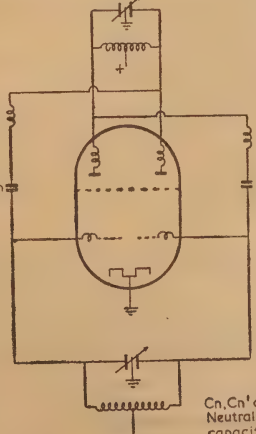


FIG 5.

The earliest remedy to this problem was to incorporate two screen-grid valves in one envelope, with the screens and cathodes connected together by low-inductance straps, the centre point of a strap being brought out as a pin connection.

The two halves of the valve were operated in a balanced push-pull circuit, and since equal and opposite radio frequency currents flowed in the common screen and cathode leads their inductances were rendered unimportant. A typical circuit arrangement, showing stray inductance is illustrated in figure 1 below.

The existence of two separate electrode structures side-by-side in the envelope necessitated rather long grid and cathode straps, however, and these possessed sufficient self-inductance to cause undesirable feedback at still higher frequencies. At these higher frequencies, Fig. 1 ceases to be an adequate representation of the circuit, which becomes more like Fig. 2. The effects of Lk, Lk', and Ls, Ls' are not cancelled by the push-pull connection.

In the current range of Mullard VHF double tetrodes an improved method of construction is used to

**PRINCIPAL CHARACTERISTICS OF THE QQV03-20***

| HEATER | Series | Parallel |
|---|---|---|
| Vh | 12.6 | 6.3V |
| Ih | 0.65 | 1.2A |

**CAPACITANCES**

Each Section

| | |
|---|---|
| cg1-all | 6.5 $\mu\mu$F |
| ca-all | 2.0 $\mu\mu$F |

Two Sections in Push-Pull

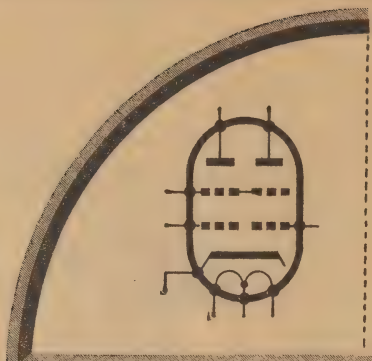
| | |
|---|---|
| cout | 1.3 $\mu\mu$F |
| cin | 4.0 $\mu\mu$F |

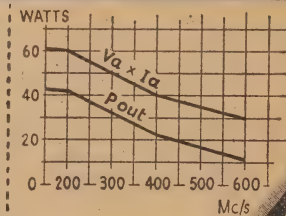
**LIMITING VALUES**

As Class "C" push-pull amplifier for C.W. Telegraphy or for F.M.

| | |
|---|---|
| Va max. | 600 V |
| pa max. | 2 x 10 W |
| Vg2 max. | 250 V |
| pg2 max. | 2 x 2 W |
| Vg1 max. | -75 V |
| pg1 max. | 2 x 0.5 W |
| Ik max. | 2 x 55 mA |
| f max. (at reduced ratings) | 600 Mc/s |

BASE B7A




*CV2799

# *A high performance Double Tetrode for the new U.H.F. wave-band allocations*

Providing 15 watts output at 500 Mc/s, and with an effective upper frequency limit of 600 Mc/s, this new Mullard double tetrode, the QQV03-20, is an ideal valve for communications equipment designed to operate in the new U.H.F. wave-band allocations.

As a result of new and important design features, this valve has the outstanding advantages of high anode efficiency, excellent power gain, low filament consumption and small physical dimensions. In addition, being of conventional all glass technique, the QQV03-20 does not require the complex and expensive circuitry that is normally associated with the disc-seal type of U.H.F. valves.

This double tetrode has special advantages in compact communications equipment, where, due to its small size and low filament consumption, it enables maximum savings in space to be made.

Brief technical details of the QQV03-20 are given above. More comprehensive information will be gladly supplied on request.

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MR7-53

uce lead inductance to the abso- minimum, and thus permit oper- on at frequenceis as high as 600 /s. This construction is illustrated figures 3 and 4.

t will be seen from Fig. 3 that ingle indirectly heated cathode is ployed. This is of roughly rect- gular shape, and only the long es, which face the grids, are coated th emissive material. In effect, re are two separate cathodes, in- connected by the short sides of rectangle, which act as very low luctance straps.

A single screen grid is placed ound both grid-cathode systems, mpletely eliminating the effects of reen-lead self-inductance. In actice no screen decoupling capaci- is needed and the screen may connected to its high tension sup- y via a choke or resistor.

## RID-ANODE CAPACITANCE

Since this type of construction vir- ally eliminates the effects of screen id cathode lead inductance, the only maining cause of instability at HF is the small residual grid-anode pacitance. It is possible for an nplifier to become unstable at cer- in high frequencies as a result of edback through this capacitance. he effect is easily eliminated in a ush-pull stage by connecting neu- alising capacitors from the anode f each valve to the grid of the ther. If, however, these capaci- rs are connected externally, the resence of stray inductance in anode nd grid leads and the leads of the apacitors themselves, has the effect f upsetting neutralisation at high requencies. This is illustrated in ig. 5, in which the stray induct- nces are indiacted.

In Mullard VHF double tetrodes, he effect of the grid and anode ead inductances in respect of neu- ralisation has been eliminated by ncorporating neutralising capacitors nside the valve. These take the orm of small pieces of wire, in- licated in Fig. 4 as C and C', con- nected to each grid support, each xtending to a position near the node of the other tetrode. The re- ult is a true direct electrical con- nection of electrode to capacitor with- ut intervening stray inductance, and neutralising is effective at all fre- quencies.

These valves have certain inter- esting constructional features apart from the special electrode configura- tion described above.

## ROBUST CONSTRUCTION

Since VHF radio is extensively used by aircraft, specially robust construction is necessary. These valves are, therefore, manufactured with envelopes of hard glass, the top and the base being of sintered glass. The use of the latter en- ables the anode seals to be pre- formed, and thus ensures the exact location of the anodes. Two short supporting members are also moulded into the glass top, and these locate the rest of the electrode assembly accurately with respect to the anode. These supports have the further ad- vantage that they reduce vibration of the screen assembly, but their design is such that there are no detrimental effects on the high fre- quency performance of the valve.

The anodes are of molybdenum coated with powdered zirconium, which reduces secondary emission, improves radiation of heat, and acts as a getter with the important ad- vantage that its ability to absorb gases increases as the temperature is raised. The anode lead-out wires are made thick in order to reduce the adverse effects of self-induct- ance mentioned above.

A smaller single-ended double tet- rode has been developed for use up to 225 Mc/s. A number of the special features of the types descri- bed above have been incorporated in this valve, which is a miniature all glass type on the noval base, de- signated the QQV03—10. It has a rated anode dissipation of 5W per anode, and will deliver 1CW output at 200 Mc/s (Class "C" telegraphy).

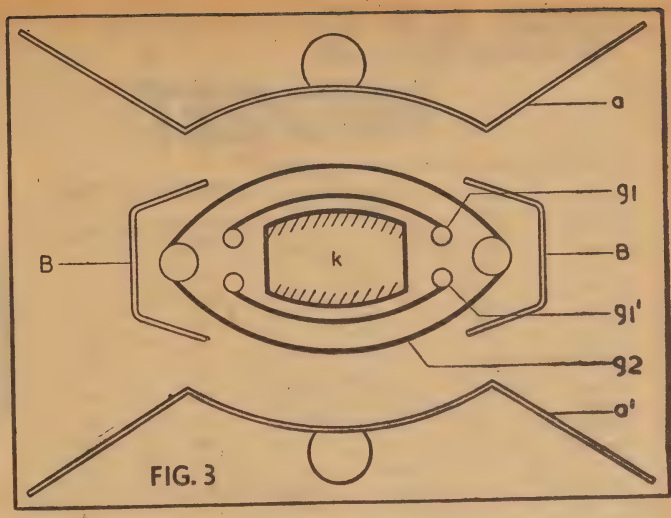

FIG. 3



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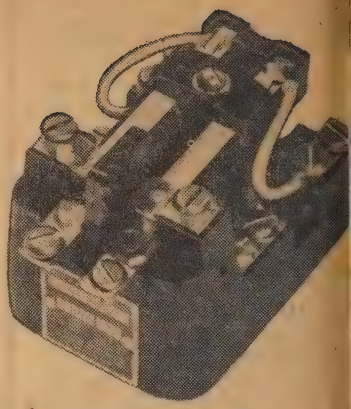
| 28306U<br>28307U<br>28308U | 2 | open<br>closed<br>open and closed |
| 28311U<br>28312U<br>28313U<br>28314U | 3 | 3 open<br>2 open — 1 closed<br>1 open — 2 closed<br>3 closed |
| 28315U<br>28316U<br>28317U<br>28318U<br>28319U | 4 | 4 open<br>3 open — 1 closed<br>2 open — 2 closed<br>1 open — 3 closed<br>4 closed |
| 28325U | 3 | 3 pole Change-over |

**OPERATING COILS**

| A.C. Voltage 50/60 cycles | D.C. Voltage |
|---|---|
| 6 | 6 |
| 12 | 12 |
| 18 | 18 |
| 24 | 24 |
| 32 | 32 |
| 110 | 36 |
| 220 | 50 |
| 440 | 115 |
| 550 | 230 |



| Volts | Each Pole amps. | 2 Poles in Series amps. | H.P. |
|---|---|---|---|
| 110 A.C. | 10 | 10 | ¼ |
| 220 A.C. | 10 | 10 | ½ |
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# FM PICKUP FOR ELECTRIC ORGAN

**Here is an article which will be of special interest to readers who have any idea of electrifying a reed organ. Translated by a member of our staff from the Dutch Radio Bulletin, the article describes a method by which signal voltages can be picked up from the reeds using FM rather than audio-electrostatic principles.**

**By D. H. MEIJER, jun.**

THERE is a number of organ designs available today, which use separate valve for each key on e scale. In these cases the name lectronic organ" is at least partly justified.

Since they sound like organs, they least have several things in common with their acoustical counterarts. What many people do not alise is that many other designs annot possibly lay claim to the ame.

Any musician will tell you that "organ" is an instrument which enerates sound by blowing compressed air into pipes of certain design. The instrument commonly nown as "Hammond Organ" is really distinct instrument of its own ght, which, apart from a limited keness in sound, has little in common with a true "organ".

## A PARADOX

This much should make it adequately clear that the expression pipeless organ", as such instruments sometimes are often advertised, is a paradox of the first order. A fitting name for the electronic rgan has yet to be found.

Almost any instrument can be imitated by means of audio generators but that does not make the audio generator an electronic piano, violin, or whatever other instrument we have chosen to imitate.

However, we do have instruments, such as the electronic guitar, which rightly have a claim to the description "electronic". Here the sound is generated in the conventional manner by strings and only the amplification is accomplished by electronic instead of acoustical means.

The purpose of this article is to describe the construction of an "electronic" harmonium. In this instrument the sound signal is generated by reed tongues vibrating in a stream of air, supplied by foot-operated bellows. The acoustical energy, however, is not directly derived from the reeds but via an electrostatic pickup system from an amplifier and its associated loudspeakers.

The simplicity of this scheme is apparent when it is compared with other methods of producing an electronic musical instrument.

We could, for example, provide an audio oscillator, of the phase shift or Wien Bridge type, and switch the necessary RC combinations to the grid of the oscillator valve by means of keys.

The idea would no doubt work. However, its one great drawback is that only one sound at a time could be produced. The depression of another key would only produce a lower note, instead of two separate notes. In other words, our instrument would be "monophonic".

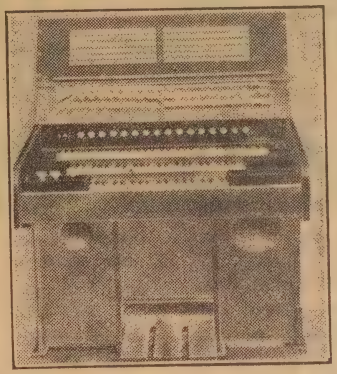
The provision of a separate oscillator for each tone required provides a way out of this difficulty but is impractical because it is beyond the means of most home constructors.

As our instrument has to be "polyphonic", that is, capable of producing more than one tone at a time, we have to find some other means of generating the tones.

## PICKUP SYSTEM

An obvious possibility is to use a system of vibrating reeds and an electrostatic pickup system. Each reed has a small metal bar opposite to it. All reeds are earthed and all bars connected to a source of high DC voltage.

A certain amount of capacitance exists between the two component masses and if one of the reeds is set into vibration, this capacitance is varied in accordance with the vibration. The vibration of capacitance results in a small charging current and a consequent voltage drop, which is applied as a signal



The finished electronic harmonium with its three manuals and 66 registers. This number does not include the original 16 reed registers. Foot operated keys have yet to be added.

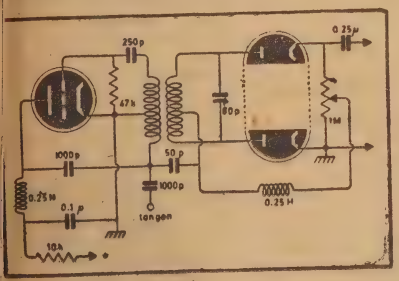
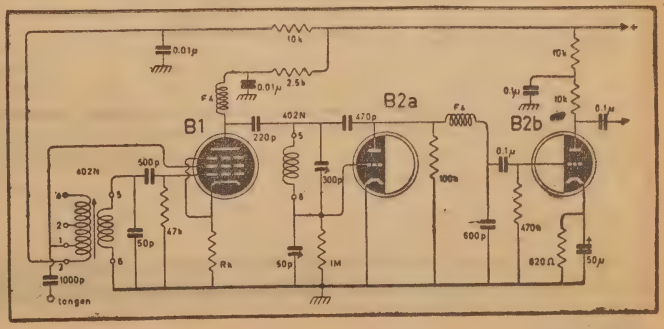



Figure 1: A simple frequency modulated oscillator and discriminator. Most suitable operating frequency appears to be about 3 megacycles. As a general rule a separate oscillator and discriminator circuit are necessary for each manual.

Figure 2: A more elaborate oscillator/discriminator circuit using a pentode and a twin trode. Operation of the circuit is explained in the text. The output of multiple discriminator circuits can be combined as indicated in figure 4.



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Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

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**OUTPUT TYPE**
**TYPE 870 — 6 watts.**
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Valves: As 931-15.
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Prim.: 6600 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60000 cps.
Valves: 807, KT66, etc.
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**TYPE 921-8: 20 watts.**
Prim.: As for 921-15.
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Valves: As for 921-15.
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Prim.: As 916-15.
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Resp.: As 916-15.
Valves: As 916-15.
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the grid of an amplifier valve.

There is a lot to be said for this arrangement, its one great drawback ing the stringent shielding requirents which are necessary to avoid cessive hum pickup by the reed emblies.

This objection could conceivably overcome by filtering out the hum t W. K. Allan, of the American gazine, Radio Electronics, found very simple and ingenious means avoiding the problem.

Instead of using the variations of pacitance to produce audio frencies directly, they are used to quency-modulate an RF oscilor.

With careful selection of the "carr" frequency, the variation yields much greater audio signal, than th straightout audio amplification. e hum problem is not so great and an additional safeguard, it can further reduced by connecting

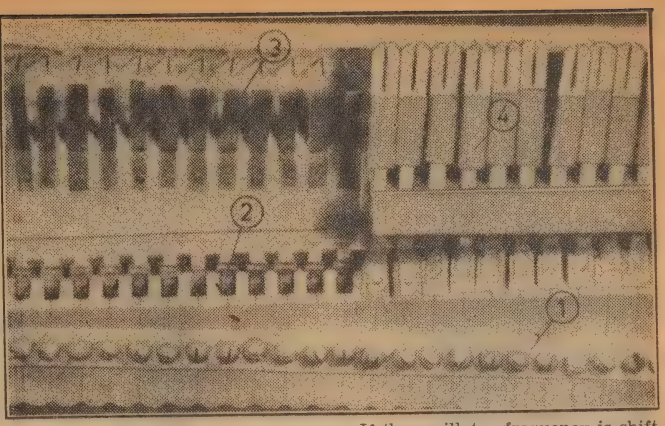



Figure 3: The reed assembly from underneath. (1) indicates the pickup screws in the metal strip, and (2) the reed tongues. Next to the arrow (2) one of the reeds is missing. The ventil springs (3), and ventil sliders (4) made this harmonium particularly valuable for conversion.

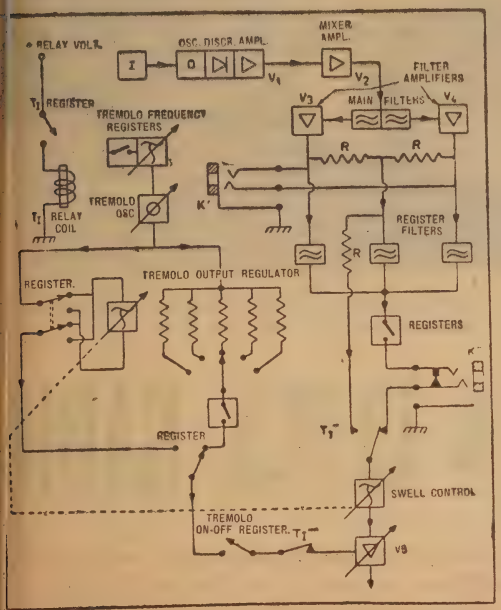



Figure 4: A block diagram of a complete organ control circuit, involving wiring amplifiers, frequency and register filters, tremulant input and so on. Such elaboration is not necessary on a simpler, single-manual organ.

1000 pf capacitor in series with he lead from the reeds.

A discriminator translates the frequency deviation of the oscillator back into an audio signal which is then amplified in the conventional manner. The basic circuit arrangement is shown in figure 1.

One FM oscillator is usually sufficient for a single manual. If more than one manual (keyboard) is used, a separate oscillator will be required for each. This is due to the fact that the ratio of capacitance between individual reeds and all reeds together is too small to give any useful variation, when two manuals are connected to the same oscillator.

Even so, only two valves are required for each manual, which is a considerable saving against one valve for each key, as required by the more complex type instruments.

Figure 2 shows a somewhat more elaborate modulator and discriminator. In this arrangement an RF pentode is used as an electron-coupled oscillator, an arrangement which prevents the plate circuit affecting the oscillator. One section of a twin-triode serves as a discriminator, while the other section is wired as a conventional RC amplifier.

It may be helpful to consider the action of the triode discriminator a little more closely.

RF output from the oscillator is fed to the triode plate through a small capacitor. The triode grid is connected to the junction of a tuned circuit, and a small variable capacitor, the DC grid return being through a 1. meg. resistor. The other end of the tuned circuit is also fed from the oscillator output.

At resonance the voltages on the two ends of the tuned circuit are 90 degrees out of phase, so that plate current can only flow during one-half of each cycle. The arrangement is self-rectifying, and RF signals are prevented from reaching the audio amplifier through the RF filter network and coupling capacitor.

If the oscillator frequency is shifted, the phase relationship of plate and grid is altered, and more or less plate curent is allowed to flow. This plate current will be in accordance with the original audio note, and the voltage developed across the plate load resistor is fed to the grid of the amplifier.

The frequency of the oscillator has to be selected so that a favorable L/C ratio is preserved up to maximum deviation in frequency. This is usually around 3 Mc.

There is not much to be said from the constructional point of view. The oscillator and amplifier can be assembled on a small chassis, which, if necessary, could be housed in the harmonium itself.

Even the pickup system isn't very hard to make. A strip of metal is first fixed to the reed cover and holes drilled through the strip and the cover, to hold the pickup screws. The holes can be tapped or, alternatively, self-tapping screws used.

The screws should be cleaned with a file and inserted so that they come as close to the free end of the reeds as possible, without touching them. This is the point where maximum variation of capacitance occurs, and is, therefore, the most favorable position.

All reeds are connected together and earthed to prevent hand-capacity effects.

The metal strip on one side and the earthed reeds on the other form the two electrodes of the pickup system.

## GENERAL ARRANGEMENT

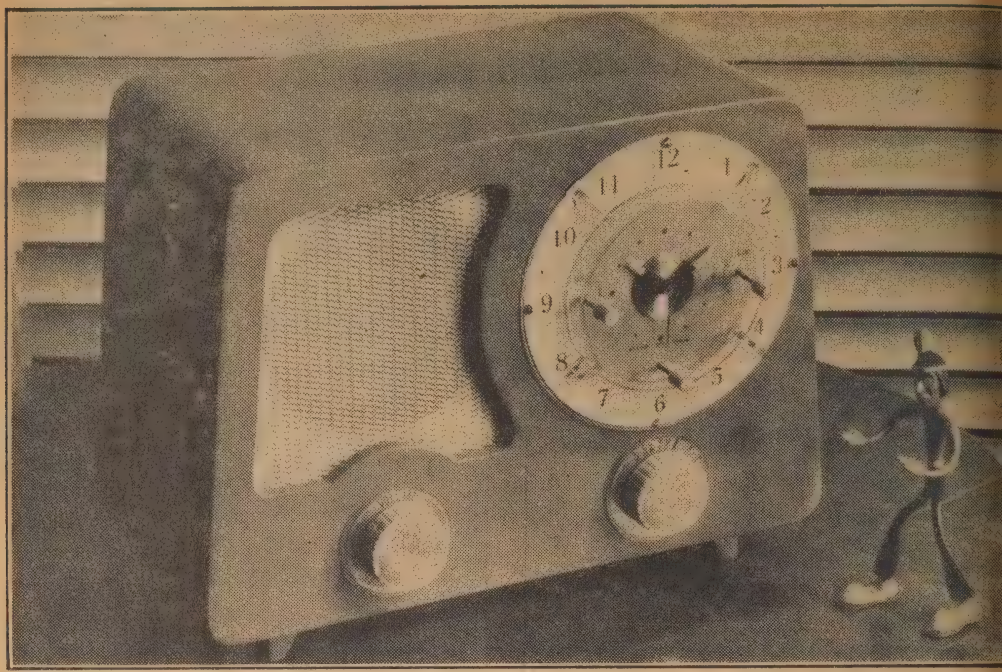
The block diagram indicates how the different pieces of equipment fit together in a complete instrument.

1 Indicates the pickup system controlling the oscillator. The oscillator output passes through the discriminator and the audio frequencies so obtained are amplified in the amplier V1.

V2 is a mixer amplifier, which allows a second and third manual to be connected without affecting the output from the first manual. This could be omitted, if the use of only one manual is contemplated.

From here the signal passes into the two main filters, and from there into the filter amplifiers. The use of main filters ahead of register filters makes the construction of the latter fairly simple. The two filter amplifiers are necessary to achieve

**(Continued on Page 121)**



This is how the set will look standing on an occasional table or a low bookcase. The color of the cabinet may be selected to harmonise with your room furnishings. We can supply the card with the printed figures.

# HOW TO BUILD A CLOCK RADIO

**Clock radios are the latest thing. The combination of an electric alarm clock and a radio set is a happy one, and greatly increases the usefulness of both. A receiver which switches on and off at given times can be used as an alarm, a programme selector, or just a common point which can give you both music and the correct time. The availability of high-class clock movements has allowed us to tell you how to make one for yourself.**

THERE are many ways in which the two can be combined physically, but we think the Kloxette will suit most readers because of its neatness, its flexibility, and the ease with which it can be adapted to your individual home color scheme.

## THE PROBLEM

Simplicity, good performance and attractive appearance make this set compare favorably with any commercially manufactured receiver.

Our problem was to evolve a suitable layout and cabinet and yet keep the whole within a reasonable size. This turned out to be much easier than anticipated, and we shall describe on these pages how we have gone about it. Following the instructions you should have no trouble at all in duplicating the original.

The choice of circuits was rather limited because we realised that nothing less than a four valve superhet would do, if the set had to come up to our expectations.

As it stands, the circuit could well be a twin brother to one of the Little General series. This is not at all surprising, for it was pointed out on the pages of this magazine some months ago that apart from different component sizes and shapes, superhets are still fundamentally the same as they were 20 years ago.

A circuit which will oust the superhet from its present dominant position has yet to be designed.

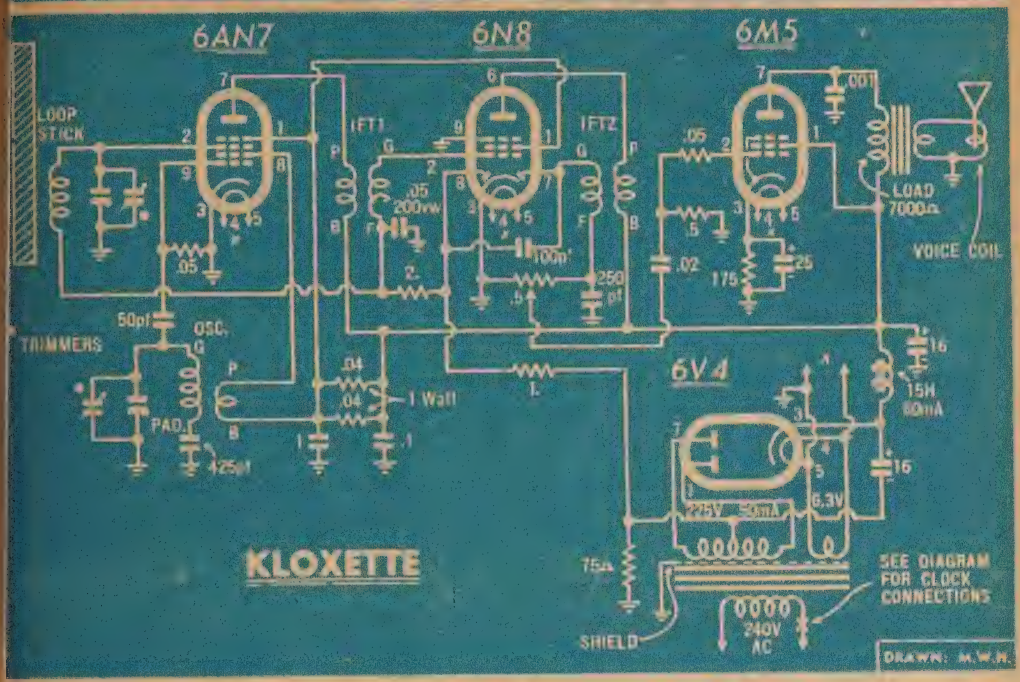
Our choice fell on a 6AN7 co verter, a 6N8 IF amplifier and d tector, and a 6M5 power outp valve. A 6V4 rectifier complet the valve line-up. A convention superhet circuit, designed to provi correct operating conditions for t valves, including AVC, fulfils a requirements.

## ROD AERIAL

Other valve types could have be used equally well, but there wou be little point in doing so, as the is nothing to be gained by it.

We have departed from the usu circuitry in one point. In ord to make the receiver independe of any aerial wire trailing arou the room, we have replaced the co

# CIRCUIT DIAGRAM OF NEW CLOCK RADIO SET




The circuit has no tricks and can be relied upon to give a good performance. Parts have been kept to a minimum.

'entional aerial coil with a Ferrite 'od aerial. Not only does this step eliminate cumbersome inside aerials, but it also reduces the amount of nterference normally picked up by small mantel set.

This does not exclude the use of conventional aerial coil, because we allowed sufficient room for one, and also for aerial and earth terminals.

Most of the room above chassis is taken up by the clock movement and the loudspeaker, so that major components had to be placed around the edges, leaving the centre free. Also for this reason, the tuning gang had to be accommodated below chassis.

Even so, there is more than sufficient space for all the wiring and smaller components.

As the front of the cabinet is largely taken up by the clock face and loudspeaker grille, we have decided to do away with a conventional tuning dial, and instead use a small vernier drive for the tuning knob. A pointer attached to the slow moving part of the drive serves to indicate the stations which are marked on a small scale around the tuning knob.

For a receiver used mainly for local stations, we have found that even the vernier attachment is not essential. Even the lady of the house will not find tuning difficult if a large knob is used to operate the dial. This fact was amply demonstrated when testing the Mantel Major.

You can please yourself about it.

Let us consider the layout and construction of this little set.

## THE CHASSIS

We built the prototype on a chassis 11 x 6 x 2-3/8in, bent up from 18g. sheet aluminium. The ends were fitted separately to make the bending operation easier. It should not be too difficult to make the chassis in a similar manner. However, we will send the blueprints to the chassis makers, and you should be able to obtain a ready-made chassis from your usual source of supply.

Looking at the chassis from the front, and starting in the right hand front corner, we have the holes provided for an aerial coil, converter valve, oscillator coil, two IF transformers with the IF valve between them, power output valve, mains transformer and rectifier valve. A rubber grommeted hole between the transformer and rectifier socket is provided for speaker leads and clock leads.

The vacant hole in the centre will allow an audio stage to be fitted at

## PARTS LIST

1 cabinet.
1 chassis 11 x 6 x 2½ in.
1 power transformer 225 V 50 Ma.
1 60 Ma. choke.
1 electric clock movement.
1 5in. loudspeaker with 7000 ohm transformer.
1 tuning capacitor, 2-gang, Min. MSP, or AWA or similar.
1 min. oscillator coil.
2 min. IF transformers.
1 rod aerial with brackets.
1 min. planetary drive
4 9-pin min. valve sockets.
1 6AN7, 1 6N8, 1 6M5, 1 6V4 valves.

Resistors:
1 2. meg, 1 1. meg, 1 .5 meg, 2 .05 meg. 1 75 ohm, all ½ watt.
2 .04 meg, 1 175 ohm all 1 watt. 1.5 meg pot.

Capacitors:
2 16 mfd 350VW electros. 1 25 mfd 40 VW electro.
2 .1 mfd 350 VW paper, 1 .02 mfd x 350 VW. 1 .05 mfd 200 VW, 1 .001 mfd 350 VW.
1 250 pf mica, 1 100 pf mica 1 50 pf mica, 1 425 pf padder, mica.
2 50 pf trimmers

Sundries:
Solder, nuts, bolts, hookup wire, 12 in. shielded hookup wire, 2 4 terminal tag strips,
4 3 terminal tag strips, 6 x 6 in extruded aluminium grille, printed clock dial, volume and tuning dial, 2 knobs, mains flex and plug; 3 rubber grommets.

# GOOD NEWS

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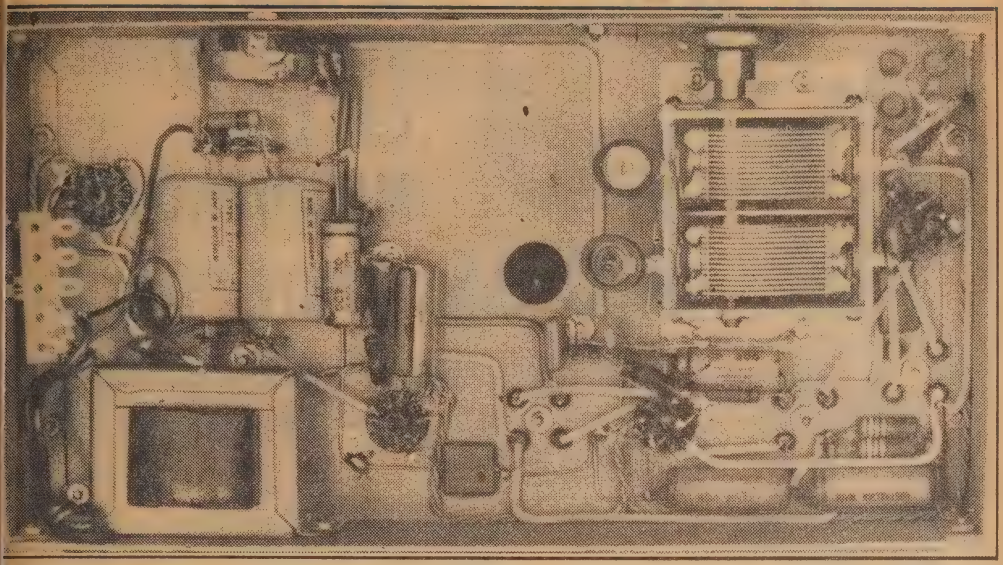
# AN UNDERNEATH VIEW OF THE NEW KLOXETTE



The layout is very clean—nearly all the components are clearly visible. Note the brackets which support the gang. The filter choke is seen at lower left—the output transformer is mounted on the loudspeaker. This chassis was fitted with a planetary drive to give vernier tuning control.

later date if you so desire.

As mentioned previously, this rangement leaves room for the peaker and the clock movement.

With a little care in socket and oil orientation a very neat and clean yout can be obtained. The gap n the converter socket points toard the centre of the chassis and ne IF socket toward the rear left and corner.

Pins P and B of the oscillator oil and pins B and G on the 1st F transformer are nearest to the dge of the chassis, as are pins P nd B of the 2nd IF transformer. oint to point wiring was employed n this section.

## TRIMMERS

The tuning capacitor with its verier drive was also accommodated n this section, adjacent to the conerter socket, near the front of the hassis. Trimmers are attached to ne gang frame, with the screws ooking downward, so that they will e accessible through the baseboard f the cabinet, when the chassis is nstalled.

Two small aluminium brackets upport the tuning gang, which is nounted horizontally.

We placed the volume control on he left hand side of the chassis, ymmetrical to the tuning knob. Shielded leads convey the signal rom the second detector to the otentiometer and on to the output tage.

Cathode resistor and bypass, and he grid stopper, are supported from n 3-lug terminal strip, which also arries the grid leak and coupling apacitor for the output stage.

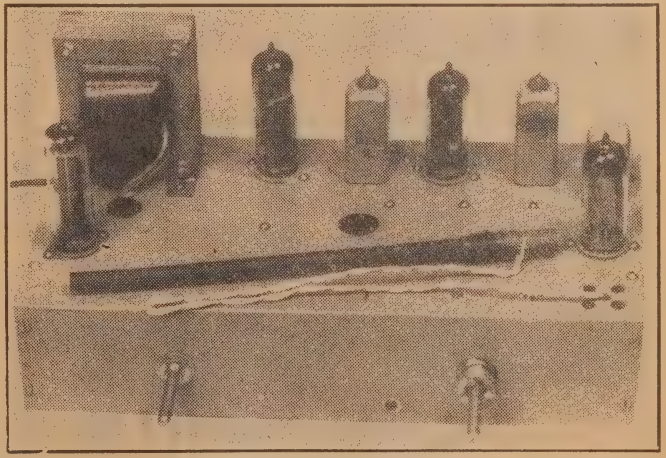
A .001 paper capacitor from the utput valve plate serves as a fixed one control.

To conserve space the filter choke is mounted beneath the power transformer at the rear of the chassis. Between it and the front we placed the rectifier socket and the filter capacitors, the latter being supported from two tagstrips. One of these terminal strips carries the back bias resistor which supplies the delay voltage for the AVC.

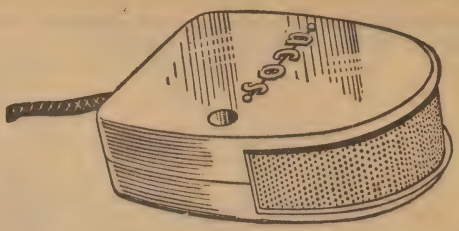
Another tag strip over the rectifier socket serves to anchor the leads from the transformer; the clock and the mains flex. As you can see, these terminals have been coded to show how the two units are interconnected.

A separate diagram shows the clock wiring to make the identification of the clock terminals possible. C is the common contact for the clock, receiver and one side of the mains. B is the other side of the mains and is carried into the clock to operate the movement and the alarm. A is connected to the second lead from the transformer, and goes to the receiver contact within the clock.

These contacts are not identified



The top of the chassis is kept clean to allow room for the speaker and the clock. Note the loopstick ready for installation in the cabinet.



# A NEW SENSATIONAL CRYSTAL MICROPHONE!

# ACOS MIC 35 (HAND AND/OR DESK TYPE)

**AT THE AMAZING PRICE OF**

**£2/15/0**

A general purpose microphone with high sensitivity and substantially flat characteristic. Housed in attractive Die Cast Case of very robust construction is particularly suitable for use in recording apparatus — Public Address Equipment — Dance Bands — and similar applications.

Provided with built-in shunt resistance of 2 megohm giving response substantially flat from 50/5,000 cps. Resistance of the input circuit will reduce the low frequency response. A grid leak of ¼ megohm will reduce the output at 500 cps by 3 dbs and pro rata at lower frequencies.

Approximate capacitance of the microphone is 750pF and cable capacitance will reduce output proportionately.

| | |
|---|---|
| Frequency response | Substantially flat from 50/5,000 cps. |
| Output level | = 55 db ref. 1 volt/dyne/cm2. |
| Load resistance | 2 megohms included. |
| Cable | This microphone is supplied with approximately 4ft. 1.2 metres of co-axial cable (type Unirad 32). |
| Weight | Microphone only — 6oz. (approx. 170 grammes) complete with packing 7oz. (approx. 198 grammes). |
| Dimensions | Microphone only 2 7/8in x 2 1/8in x 7/8in plus cable. Complete with packing 3 3/8in x 2⅜in x 2⅛in. |

Australian Agents: AMPLION (A'sia) PTY. LTD., Sydney, N.S.W.

## VALVE SOCKETS FOR EVERY PURPOSE

**EDISWAN CLIX "FLUON" SOCKETS.**

B7G 7-pin Miniature, 10/6. Screening Can 2/3 extra.
B9A 9-pin Noval, 11/5. Screening Can 2/6 extra. (For operation beyond 200 Mc).

**BELLING & LEE "NYLON" SOCKETS**

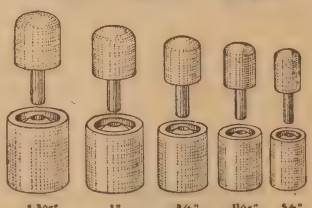
Type L718/S 7-pin Miniature, 8/-, with Can.

Type L720/S 9-pin Noval, 9/5 with Can. (For operation to 200 Mc.)

**MICA-FILLED SOCKETS—**

Teletron Type ST27-L 7-pin Miniature (less Can), 14/- dozen.
Teletron Type ST57-G/2 7-pin Miniature (with Short Can), 3/6 each.
Teletron Type ST57-G/3 7-pin Miniature (with Long Can), 3/8 each.
Teletron Type ST19/L 9-pin Noval (less Can), 16/4 dozen.
Teletron Type ST59-L/2 9-pin Noval (with Short or Long Can), 7/- each.
McMurdo 7-pin Miniature (with Can), 3/8 each.
McMurdo 9-pin Noval (with Can), 7/- each.
Belling & Lee B8A Bakelite Wafer Socket, 2/3 each.

## "WILLIS" CHASSIS PUNCHES




Manufactured especially for the Radio and Electronic Engineer and Constructor. Gives that "clean cut" professional appearance.

| | | | |
|---|---|---|---|
| 3/8in .. .. | 19/6 | 1in .. .. .. | 29/10 |
| 1/2in .. .. | 19/11 | 1-3/16in .. | 33/2 |
| 5/8in .. .. | 19/11 | 1-1/4in .. . | 40/- |
| 11/16in .. . | 21/6 | 1-1/2in .. . | 45/- |
| 3/4in .. .. | 23/3 | 2in .. .. .. | 60/- |

Special Sizes Made To Order.
Guaranteed 10,000 holes, made of Finest Grade Tool Steel.

**SMITH 24-HOUR**

**"WORLD CLOCK"**

Gives the Time in All Countries of the World at a glance and indicates Day or Night. **PRICE £8** plus 5/- postage and packing.

## AERIAL "T" CERAMIC INSULATOR

**The only insulator for firm aerial feed connection.**

**BELLING & LEE TYPE L333.**

**"SMITH" ELECTRIC PRE-SET CLOCK**

**BUILD A CLOCK RADIO**

As per this issue of Radio & Hobbies

**£5/19/6**

Plus 4/- Postage

**WILLIAM WILLIS & CO. PTY. LTD.**

**428 Bourke Street, Melbourne, C1.**

Phone MU 2426

the clock movement, and it will necessary to trace the wiring ough with the aid of the clock cuit. A little care on this point l save a blown fuse and damaged ck contacts.

ne clock leads, as aker transformer primary leads, l need to be attached to the re- ctive terminals and brought out the top of the chassis before it be placed into the cabinet. We y also mention here that the aker transformer is mounted on loudspeaker.

After attaching the "loopstick to receiver, and a thorough check the wiring, the set could be put o operation to see that every- ng, including the clock, is work- correctly.

Also at this stage the IF channel uld have to be aligned. The gnment of the oscillator will have wait until the receiver is mounted the cabinet, as the dial scale is manently fixed to the front panel. And now to the cabinet.

In the past, many of our receivers re accommodated in leatherette vered wooden cabinets which were rable, useful, and attractive.

## ABINET

But it is not at all hard to hand- shion an attractive cabinet at me—if you are a carpentry hobby- you will probably prefer to do . There is nothing which looks tter than a well made wooden binet, and in a modern home, a cquered finish is often the most itable and the simplest to achieve. Because the clock face has to be commodated, there is quite a field r would-be designers, but we have ade here a suggestion which we ink looks the part, and can be ade by anyone with ordinary home ols.

This cabinet can be satisfactorily nished and looks well in a ariety of colors, although specific- lly intended for a single color only -all blue, all red, or even a natural ood color which might look best f all if it matches your room.

As a bed-side set to sit on your ight-reading bookshelf it would ok just fine, and be ready to wake ou in the morningn.

## IMENSIONS

In the cabinet shown in our open- ng picture, we have laid emphasis n the numbered dial which will llow you to read time easily and learly. There are many other ways f marking out the hours if you ave your own pet method, and ome imagination to go with it!

The cabinet, roughly 13 x 9 x 6¾in, s made from 3/8in plywood, with loping sides and rounded corners. Exact measurements and angles of lope are given in the diagram.

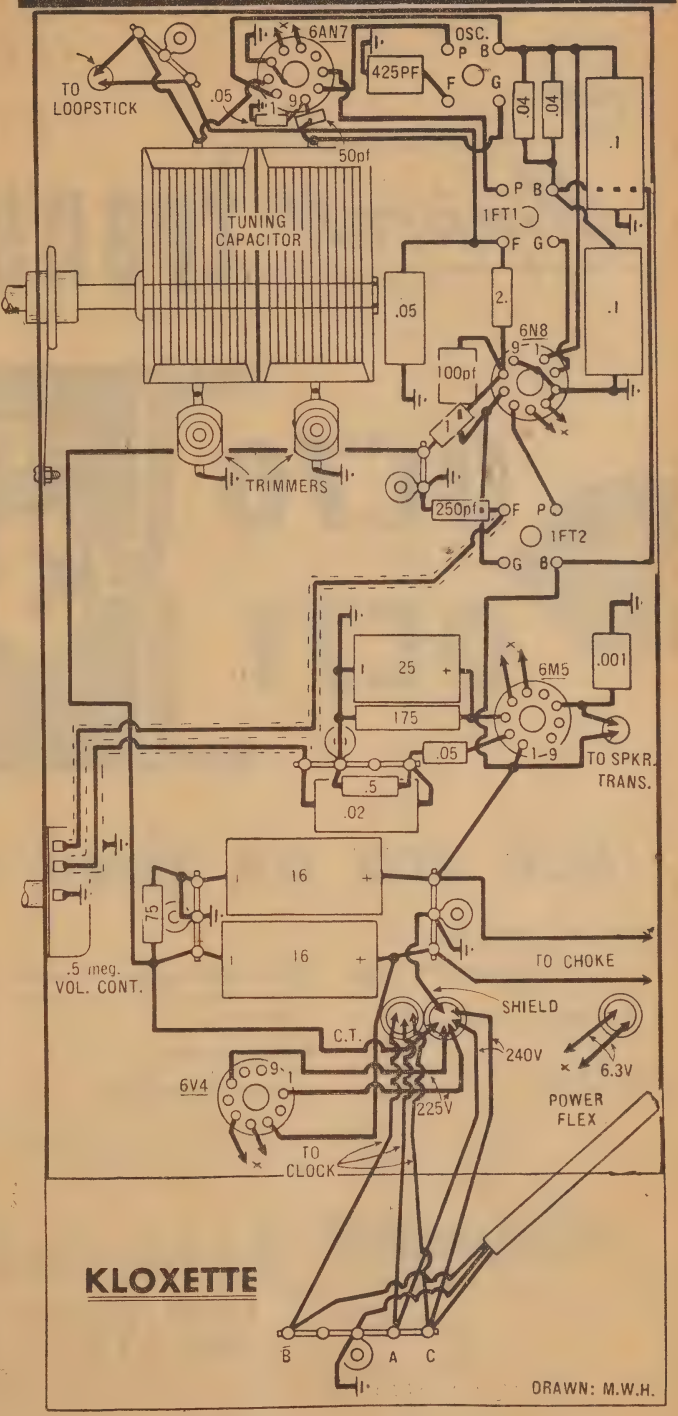
To start on the cabinet, it would e best to cut out the front panel, vith square corners for the time eing, and, with a coping saw, make he clock and speaker cutouts. Holes or the control spindles could also e drilled at the same time.

One or two different clocks are available at present. This means that he cutout for the clock will have e made to suit the particular model ou will be using. The details given n the diagram are for the more opular model.

It will also be necessary to make recess of approximately 1-8in around the cutout to allow the actual

**(Continued on Page 73)**

## THE RECEIVER WIRING DIAGRAM




This diagram will help you with the layout and chassis wiring.

PHILIPS

# *Miniwatt* transistors

TYPES **OC70**
**OC71**

**NEW PRICE**
**37/10**
**each**

## *their uses are almost unlimited!*

*Here are just a few*

- Low frequency amplifiers with one transistor.
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- Hearing aids.
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- Home telephones.
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- Low frequency oscillator.
- Signal tracer.
- Radio receivers.

*Send for data sheets without obligation.*

*Miniwatt* **DIVISION**

**PHILIPS ELECTRICAL INDUSTRIES PTY. LTD**
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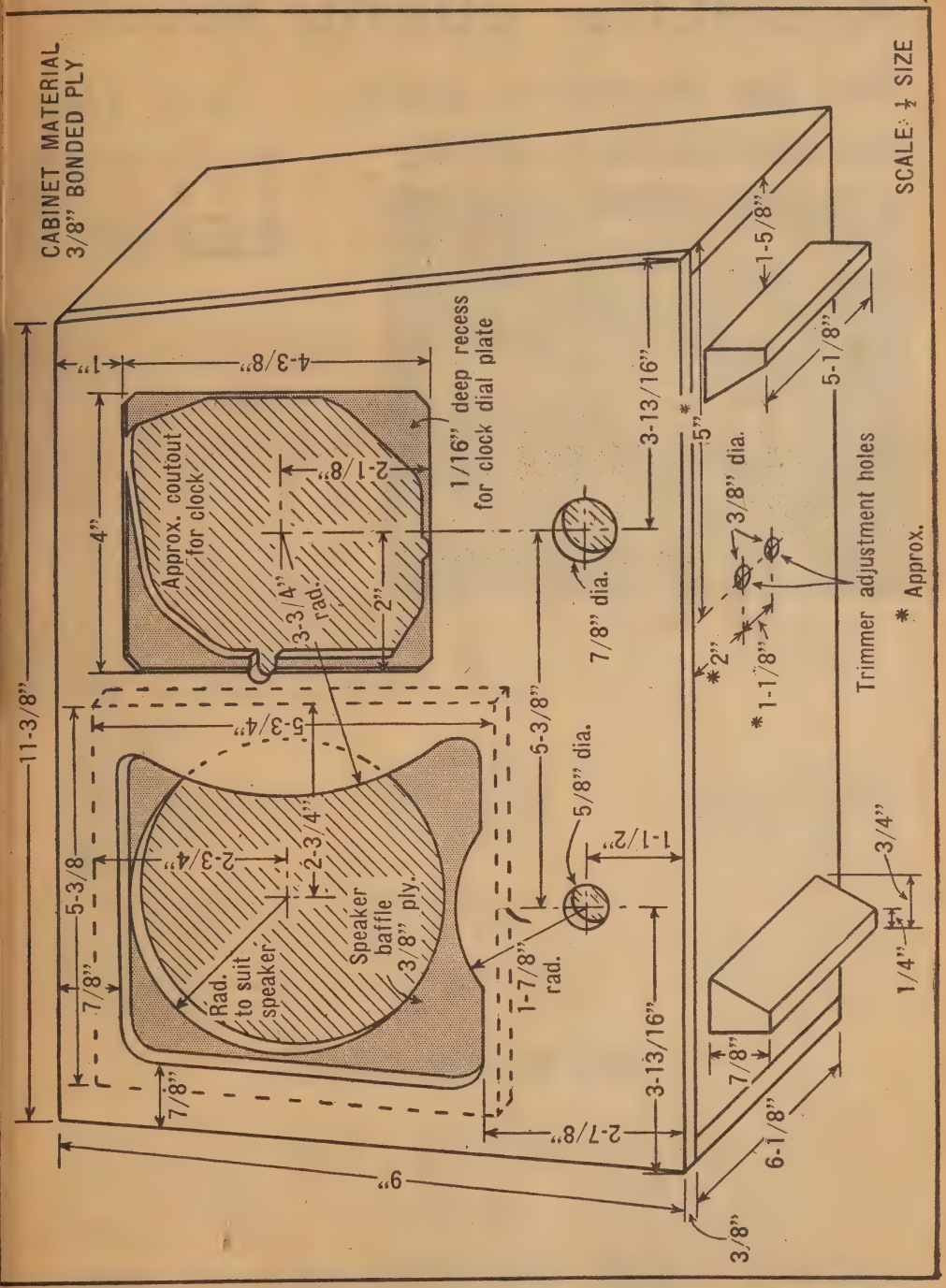
PV7.55

# MAKE YOUR OWN CABINET FROM THESE DRAWINGS

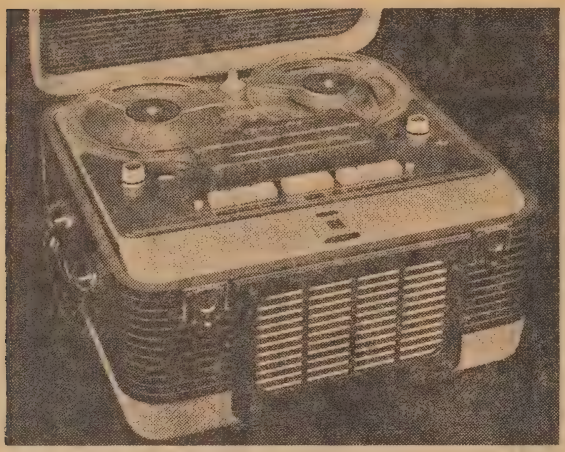



Any home handyman can make up the cabinet, and there is no objection to varying the fret layout, for instance, if you have other ideas. Do not reduce any cabinet dimensions, otherwise you may be in difficulties when fitting the chassis, speaker, or clock movement.

# MAGNETIC SOUND INDUSTRIES

## More Tape Recorders on display than anywhere else in Australia

**From £65**
**or £10 deposit**

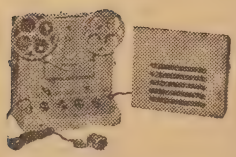


**GRUNDIG**

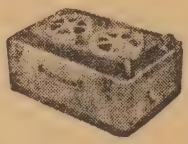
TK819 A two-speed Tape Recorder with three full hours' recording on one spool of tape. The Sound Frequency range extends from 40 to 14,000 c.p.s. at a tape speed of 7½in per second. A high-speed rewind mechanism and a unique Clock Timing indicator return you to any part of the Tape you select in seconds. Simple, fool-proof controls, all clearly marked, give you complete and instant mastery of both recording and production. £200, or on terms at £50 deposit. With all new Tape Recorders there are given two reels of tape.

## SPECIALS

Special release of Radio-Tuner, beautifully finished in plastic case—no power required, plugs into microphone socket and your Tape Recorder becomes a radio. Only **£6/19/6.** High fidelity 3-valve radio-tuner, 240 volt operated, plugs into any Tape Recorder. **£19/10/-.**



TECHNICORDA. A tape recorder with separate speaker and public address system. A one-speed tape recorder that gives perfect high fidelity recording. £75.



ELCON. A special one-knob control Tape Recorder that records, plays back and rewinds both ways. Australia's finest tape recorder. Public address amplifier is built in. One Elcon for £75, another for £105.

GRUNDIG. Special demonstration model TK9 to clear at £130 and one slightly used model for £105. Other Tape Recorders for sale. Pyroxmatic excellent order for £79/10/-. Elcon £65 and Tecnicorda £69/10/-.

## HOME BUILDERS SECTION

**HIRE—**

We will hire you a Tape Recorder, day, night or all weekend, Reasonable charges.

We have now opened a home builder's construction section and we stock all the parts you need to build a cheap but efficient tape deck, all parts are fully guaranteed. MAIL ORDER WITH CONFIDENCE. Please add postage.

| | | | |
|---|---|---|---|
| Flywheels and Capstan | £3/19/6 | Spring belts | 2/6 |
| Reel holders | | Idle wheels | 10/6 |
| ¼in and 3/16in | 12/6 | Guide posts | 10/6 |
| Pinch Wheels | 10/6 | Motors B.S.R. | |
| Spindles | 7/6 | 3/16in shaft | £3/15/- |

**TERMS—**

Magnetic Sound Industries offer you the best terms in Sydney, private and confidential.

## MAGNETIC SOUND INDUSTRIES 387 GEORGE STREET,

**FIRST FLOOR (OPPOSITE NICHOLSON'S) BX4440, BX4587**

ck face to come flush with the nel.

Then the top, bottom and two side nels could be cut, and the side ges planed to suit the angle of pe. Making sure that all sides e a neat fit, they can be sand- pered, glued together and fixed th small panel pins. These pins ll have to be punched well below e surface so that the corners can rounded when the glue has set. Before assembling the cabinet, it uld be wise to make and attach e legs to the bottom panel. They e best glued on and nailed from e inside.

The assembled case should be left at least 24 hours before attempt- g to round the corners, to allow the ie to set properly. It would not a bad idea to place a weight on o during this time.

When the glue has set, the corners n be rounded with a rasp, or plane, a garnite sanding disc. Beware nail heads, if using the plane!

Radius of the corners is approxi- ately ¼in. This leaves sufficient nber in the corners to give equate support to the cabinet thout the need for internal corner aces.

A thorough sanding of the surface d the edges makes the cabinet ady for painting. Color or colors ould be selected to match the color neme of the room the receiver is be used in. Our set was painted cherry red, which gave a very fective combination with the dull ld of the clock face and the dials. One undercoat and two coats of int should be all that is neces- ry to give a nice smooth surface.

## ATCH THE DUST

We need not mention the fact at the cabinet is best left alone a dust-free place until the paint is thoroughly dried. After that ie receiver can be mounted in ace.

Owing to the shape of the cutout e speaker will have to be mounted a small baffle of suitable dimen- ns, made also of 3-8in plywood. Extruded aluminium was used as eaker grille in the original model. s can be seen from the photo- aphs, it matches excellently with e contemporary design of the binet.

There are only one or two clock ovements available at present, and e one we have used is the most pular. As it has no numbered al, we can make available a print- d card from which you can cut a rcular number plate for insertion nder the perspex cover supplied ith the clock. The cost is 1/- plus stage.

If you don't want the numbers, ou could paint the flange of the erspex cover with gold paint (try match the clock face) and per- aps touch in the markings on the ce of the perspex with phos- horescent paint to make them minous. In all cases, however, ou will find clock mounting easiest you use this perspex front to hold to the front of the cabinet.

The perspex cover supplied with ie clock is somewhat smaller in iameter than the diagonal of the ectangular clock face. To avoid howing the corners outside the dial, ie corners of the clock face will eed to be trimmed to fit within ie diameter of the perspex.

Smaller perspex plates with station alibration transfers for each State nd volume indication, of the same type as described for the Mantel Major, have been made available by Aegis. They are affixed to the front panel and may be used just as effectively with a plain knob tuning control.

A handy station pointer can easily be made from a small piece of celluloid.

The loopstick could be fixed to the top panel with two small aluminium brackets. This and the connection of the clock contacts should complete the receiver, with only the alignment to be done.

As mentioned earlier in this article, the alignment will have to be done partly with the receiver in the cabinet and the scale and pointer fixed. Holes to give access to the trimmers and the oscillator coil core are provided for in the cabinet diagram. Apart from this the alignment procedure is the same as for any other superhet.

An electric clock isn't much use unless you know how to operate it, particularly one fitted with special features. Here, then, are some

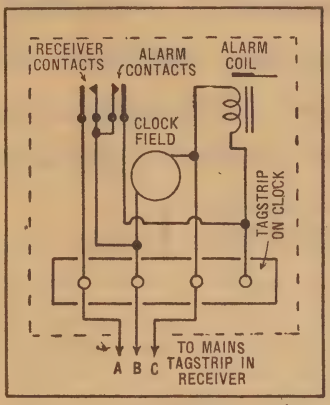



Diagram showing the clock wiring and connections to the receiver. There are only two sets of contacts and the different control settings are mechanically interlocked.

general remarks which apply particularly to the clock we used, and probably to any others you are likely to come across.

The clock will usually have three controls, marked "Sleep", "Alarm" and "Alarm-Off-Manual". We will call the latter the Function Switch.

These markings are self-explanatory if you know what they mean, but they do not indicate all the things which the clock can be made to do.

The control marked "Sleep" actuates a delay mechanism, allowing the clock to switch off the receiver up to 60 minutes after it has been set.

Another control marked "Alarm" serves a dual purpose having both a rotary and a push-pull action. Turning it will set the small dial underneath the hands to the time the receiver is to be switched on. A small pointer attached to the hour hand indicates the setting.

Pulling this knob out will connect a buzzer into circuit which comes into operation 15 minutes after the receiver has been switched on by the clock. Although this buzzer does not give off a raucous sound, it is loud enough to make sure you will not sleep through it.

The "Function Switch" allows either or both of the above controls to be brought into operation and in addition provides for manual control of the set.

There are many ways in which these three controls can be combined and it may take some time to get used to them all.

Supposing you go to bed and want the set off at 11 pm. Also you wish to be woken up at 7 am next morning.

At 10 pm you set the Function Switch to the "Alarm" position. This will bring the other two controls into circuit. Then you turn the "Sleep" knob clockwise until it points to 60 on the adjacent scale. This will allow the mechanism to switch off 60 minutes after you set the control, that is, at 11 pm.

Now you pull out the knob marked "Alarm" and turn it until the pointer indicates 7 on the small centre scale. You may then go to sleep contentedly, lulled by sweet music, and the clock will switch off the receiver at 11 pm when you are safely in the land of nod.

## DELAYED ALARM

At 7 am next morning the receiver will come on, and if this should not wake you, at 7.15 the buzzer will go off. Of course, you will have to tune the receiver to the station you wish to listen to before you go to sleep.

When you go to work, you turn the Function switch to "Off" switching off the receiver.

If you don't want to miss your serial in the evening, you again turn the Function Switch to the "Alarm" position and set the centre dial to the time the broadcast is scheduled. Then you push the control knob marked "Alarm" in again. If you omit to do this, the buzzer is likely to go off just at the most exciting moment of the serial.

For ordinary daytime listening the Function Switch is turned to the "Manual" position.

These are typical uses for the clock, although there are many other combinations which can be used to suit individual need. However, it must be remembered that the "Sleep" control cannot be set further ahead than 60 minutes, calculated from the time of setting.

The hands can be adjusted by means of an extension shaft and knob from the rear, whenever this becomes necessary.


AWA
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MICROPHONES & ACCESSORIES

Type C53
£4'19'1
Hand or stand mounting, omnidirectional, black plastic housing and hand grip. Ideal for tape recorders and similar applications.
NEWTON McLAREN
17 LEIGH ST., ADELAIDE
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Goldring

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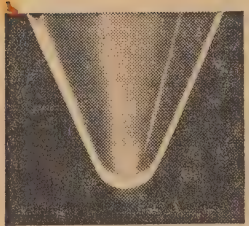
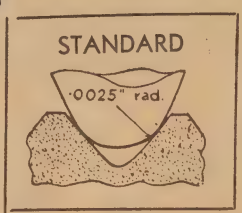


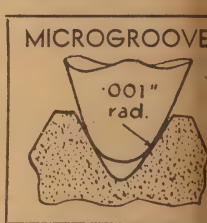
***Shaved & polished by hand from genuine natural diamonds to the exact dimensions essential for perfect reproduction!***

DIAMOND STYLUS
after
1000 PLAYINGS

Micro-photograph shows entire absence of wear and perfect contour after 1000 playings on "78" shellac discs.




Goldring Diamond Styli ride correctly on the sides of the groove. Inaccurate needles will either ride on the bottom of the groove, causing undue noise and loss of reproduction quality, or will skate across the record.




## ESSENTIAL FOR HIGH FIDELITY

- ★ ***CANNOT BE FRACTURED IN USE.***
- ★ ***UNCONDITIONALLY GUARANTEED for 6 months against fracture, chipping or accidental damage.***
- ★ ***NO RECORD DAMAGE due to worn or deteriorating styli.***
- ★ ***NO FREQUENT STYLUS CHANGING.***
- ★ ***MORE ECONOMICAL THAN ANY OTHER TYPE of STYLUS IN TERMS of RECORD "MILEAGE".***

Now, with the sensational Goldring Diamond Stylus, you can enjoy better reproduction all the time. No danger of accidental chipping—the genuine diamond point is the hardest substance known. The polished Goldring "Ball Point" glides through the grooves, with perfect compliance and frictionless, non-wearing, noise-free smoothness . . . an investment in musical enjoyment, an insurance policy for your records!

**RETAIL PRICE £6/10/- (Standard or microgroove)**

**The following diamond styli (standard and microgroove sizes) are now available:**

**D/7—D/8—D/9—D/16—D/17—D/20—D/24**

For special types of cartridges not listed in the Stylus Reference Chart—Connoisseur, Decca, Dual, etc.—send the complete cartridge (or armature, stylus holder or stylus —whichever is applicable) to Goldring Engineering for fitting. Fitting and delivery will be effected in 6-8 weeks.

If Goldring Diamond Styli are not obtainable from your usual retailer, contact the Australian Distributors, to whom trade inquiries should also be addressed.

## Goldring Engineering (Aust.) Pty. Ltd.

**57 H.E. AREA, ST. MARYS, N.S.W. Phone B0701 Ext. 447**

### *HOW THE GOLDRING* DIAMOND STYLUS *PROTECTS YOUR RECORDS*

All other softer types of styli eventually wear to chisel edges which gouge records and distort tone quality.

**Polished Goldring Diamond Point protects grooves, extracts the full recorded frequency range.**

### ORDER THE CORRECT STYLUS

Fill in this coupon, and take to your retail
If he has not the correct stylus in stock, h
him to obtain it for you.
MAKE of RECORD CHANGER, MOTOR-PICK
UNIT, or PICKUP.

.....

Model or type No. .....
State whether Microgroove or "78" sty
(or both) are required .....
Refer to Goldring Stylus Chart on the follo
ing pages for assistance in selecting
correct type of stylus.

# Goldring NEEDLE STYLUS 1955/56 REFERENCE CHART No. 3

**Recommended replacement types and Fitting Instructions**

**check for detail only . . . Styli are not necessarily shown in actual Size.**

| TYPE | RECOMMENDED FOR | Instructions for Needle Change. | PRICE |
|---|---|---|---|
|  S/1 | Light crystal pickups. | Tighten with Needle Screw. | 10/6 |
|  S/3 | Connoisseur, Goldring 121, 122, H.M.V. and other lightweight pickups. | Insert without side pull or bending, as deeply as possible. | 10/6 |
|  S/6 | Record changers and both crystal and magnetic pickups, minimising record wear. | Tighten with Needle Screw. | 10/6 |
|  150 | Goldring 3-way pickup. | Insert without side pull or bending, as deeply as possible. | 12/6 |
|  S/7 Diamond D/7 | Goldring turnover pickup, B.S.R. unit GU.4, Stromberg-Carlson changer, Garrard changer, Acos pickup, etc. | Turn cartridge until styli holding screw in centre of cartridge shows. By unscrewing it, both styli can be withdrawn simultaneously and new styli inserted, making sure that the flats of these go in first. | 12/6 |
|  S/8 Diamond D/8 | B.S.R. UNIT GU.4<br>B.S.R. Monarch record changer and cartridge T.C.2. | Fitting Instructions for Types S/8, S/9, S/10, S/11, S/13, S/24.<br><br>Withdraw old needle styli by gentle but straight pull and insert new styli without using force in the same manner. Using force would damage pickup mechanism as well as possibly snap off cantilever of stylus. If cartridge is inaccessible for effecting styli change while cartridge is in position, it can easily be removed in all cases by unscrewing cartridge from pickup arm. | 12/6 |
|  S/9 Diamond D/9 | Various Acos cartridges. The main difference between S/8 and S/9 is length and angle. As the angle cannot be re-set watch this point carefully. S/9 used by Collaro, Garrard, Acos and others. | | 12/6 |
|  S/10 | Goldring Magna cartridge No. 200. | | 12/6 |
|  S/11 | Plessey Changer. | | 25/- |
|  S/13 | Garrard "Astatic" U.S. | | 12/6 |

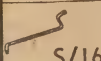
**COLOUR CODE:—RED FOR MICROGROOVE: GREEN FOR STANDARD 78.**

*These styli cover almost all the equipment sold in Australia. Regarding new and off-standard types refer to Goldring Service Department for information and help. All Goldring needle styli are of finest quality and produced to most exacting standards, backed by long experience. Prices kept at lowest economical level. Do not confuse with cheap needles on the market. Insist on genuine Goldring replacement styli.*

**ALWAYS SPECIFY WHETHER FOR MICROGROOVE OR STANDARD DIAMOND STYLI.** Diamond Styli are available with the prefix "D" in place of "S" for the Sapphire types shown on this chart.

e.g. for Collaro.

Sapphire — S 17.
Diamond — D 17.

| TYPE | RECOMMENDED FOR | Instructions for Needle Change. | PRICE |
|---|---|---|---|
|  S/14 | Garrard Astatic Crystal Pickup. | 1. Remove worn needle by prising upward with a penknife blade under rear of needle.<br>2. Insert shank of replacement needle and press down gently at base of shank. | 12/6 |
|  S/15 | Acos GP.33. | Withdraw old stylus by straight but gentle pull, and insert new stylus—pressing gently in to the correct depth. | 12/6 |
|  S/16 Diamond D/16 | For latest imported record changers, and Acos HGP.37. | Grip stylus arm immediately above stylus . . . continue lifting operation through 90° . . . pull gently. This will remove stylus from bush. To replace, reverse operation. | 12/6 |
|  S/17 Diamond D/17 | For Collaro, Ronette, A.W.A. | Remove screw holding old stylus. Replace with new stylus. Tighten screw carefully. | 12/6 |
|  S/18 | For Garrard Crystal Cartridge GC.2 (A.54). | 1. Remove worn stylus by prising upward with penknife blade under rear of stylus.<br>2. Insert shank of replacement stylus and press down gently at base of shank, making sure that the two ears on stylus bar fit over plastic coupling. | 12/6 |
|  S/19 | For Garrard Turnover Magnetic Pickup. | With pickup in L.P. position, remove arm. Unscrew and remove stylus plate. Lift bridge piece and stylus assembly off stylus plate. Place new stylus assembly in stylus plate. Refit bridge piece. Replace stylus plate in cartridge—red spot to front. While tightening screws, check that armature is central. | 30/- |
|  S/20 Diamond D/20 | Goldring Variable Reluctance Cartridge No. 500. | To remove stylus unscrew metal strip through which stylus is protruding and pull out stylus together with damping material. When replacing stylus push damping material gently into recess provided for it and make sure stylus is straight before replacing metal strip. | 12/6 |
|  S/24 Diamond D/24 | G.P.19, HGP.39, HGP. 41, HGP.45. | SEE S/8, S/13 SERIES. | 12/6 |
|  S/25 | HGP.59. | Pull stylus gently forward without moving damping material in which stylus is embedded.<br>To replace stylus reverse this operation. | 12/6 |
| High fidelity pickups with styli as integral part of their construction. | Styli, being an integral part of pickups in this group, cannot be supplied. New styli will be fitted at moderate cost by Goldring Service Department, 57 H.E. Area, ST. MARYS, N.S.W. Please take cartridge to your retailer, who will make necessary adjustments. The best known pickups in this group are the Goldring Headmaster and the Decca magnetic pickup. In the case of the latter it will be sufficient for armature to be sent in to effect styli replacement. | | Price on application to Goldring Service Department. |

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Faulty, chipped or dust-laden records can have disastrous results. The weight, damping and tracking of your pickup affect the rate of wear. And, most important, the method of handling (gentle or otherwise) — either manually or by the record changer.
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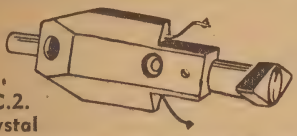
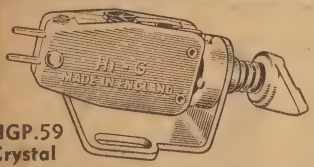
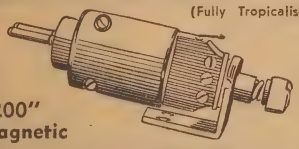
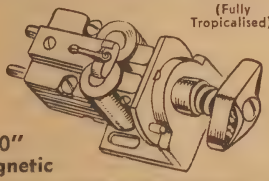
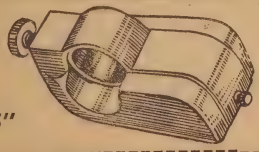
Goldring

# PRICE LIST
# PICK-UP HEADS
## and CARTRIDGES

| TYPE NO. & ILLUSTRATION | APPLICATION | DATA | PRICE |
|---|---|---|---|
|  T.C.2. Crystal | • MONARCH CHANGER<br>• B.S.R. GU. units<br>• Goldring Turnover Pick-up etc.<br>• Goldring Playgram | OUTPUT: 1 volt<br>Frequency Range 30-7,000<br>Styli-S8 ½in. mounting | 60/- |
|  HGP.59 Crystal | • B.S.R. Units GU.4<br>• Stromberg Carlson Changer (Velvet Action) | OUTPUT: 1 volt<br>Frequency Range 30-8,000<br>Styli-525 ½in. mounting | 60/- |
|  HGP.37 Crystal | • MONARCH CHANGER<br>• IMPORTED CHANGERS<br>• AUSTRALIAN CHANGERS | OUTPUT: .6 volt<br>Frequency Range 30-10,000<br>Styli-S16 ½in. mounting | 60/- |
| (Fully Tropicalised)  "200" Magnetic | • Goldring Magnetic Turnover Pick-up<br>• MONARCH CHANGER<br>• B.S.R. unit GU.4 | OUTPUT .5 volt<br>Frequency Range 40-6,000<br>Styli-S10 ½in. mounting | 60/- |
| (Fully Tropicalised)  "500" Magnetic | • VARIABLE RELUCTANCE PICKUP No. 500 | OUTPUT 10 Millivolts<br>Frequency Range 20-16,000<br>Styli-S20 ½in. mounting | £5/5/- |
|  "185" | For adapting acoustic gramophones to electrical reproduction. | OUTPUT .5 volt<br>Frequency Range 50-6,000<br>Styli-standard Steel or Fibre | £2/5/- |

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# Here's your answer, Tom!

**A professional quizmaster could not present a bigger assortment of questions than Tom has during these past few months. And to top it all, he does not stick to the good old standby questions on "how the dry battery works", or "what is inside a headphone". This month's question could well be the subject of a dissertation by a bearded pioneer.**

THE humble writer of this page, who is not a bearded pioneer, is left scratching his head, wondering, "Where do I come in?"

Be that as it may, however, we'd better look the lion in the eye and do the best we can. Here is the question:

**How and why did radio sets grow up? What I mean to say.. is that thirty years ago people were content with crystal sets, while today, anything having less than five valves is sneered at, even though most people only worry about the seven o'clock serial from one or the other of the commercial stations? And isn't it true that you often get.. better results from a small two-valve reaction set, than from one of the modern five-valve receivers?**

If there ever will be a competition for curly questions, Tom, this one is sure to be a winner! Let us have a closer look at the problems involved.

First of all, let us clarify the position. At this moment we are mainly concerned with receivers, which are

*"Not a bearded pioneer . . ."*

used by the average listener. Now the "average listener" is essentially a non-technical person, who knows very little, if anything, about the way radio works. Therefore, the operation of a radio receiver must be as simple as possible. Curiously enough, this fact largely accounts for the size of the present-day radio receiver.

By size, in this case, we do not refer to physical dimensions, but rather to the number of valves and tuned circuits. Physical size as such is not significant, because of the miniature valves and components which are used almost universally today.

Let us have a look at the development of the radio receiver as a mass entertainment medium. This development began when the manufacture of valves became sufficiently advanced to allow mass-production with the consequent lowering of prices. This brought the cost of radio receivers within the reach of the average person.

Before that time, the use of radio was mainly limited to experimenting or communications using Morse Code signals. The reason is fairly obvious: The original spark transmitters could not readily carry information in other forms, and few people were sufficiently interested to master the code and spend hours and hours chasing stations with the comparatively primitive crystal receivers of the time.

## FIRST VALVE

Later on, while valves were still expensive, the crystal set did achieve some measure of popularity, although the programs received on them would hardly be considered as "mass entertainment". Normally, only one person could listen to them at a time, the tuning was very critical, the crystal and catswhisker got out of line, and, lastly, to obtain anything like an audible signal, the aerial had to be of quite generous proportions.

The thermionic valve first came into the picture at the beginning of the century, in the form of a diode. It was discovered by Fleming, who put his observations of the Edison Effect to practical use. The diode replaced crystals and other forms of detection in many commercial installations, but it still relied on energy received from the aerial for driving the diaphragm of the headphones. It did not amplify.

It was not until Lee de Forest devised a way of controlling the flow of electrons in the diode, that amplification of very small voltages, such as voltages derived from an aerial, became possible.

## OSCILLATION

Because it had a third electrode, a grid, besides an anode and a cathode, this new valve became known as a triode. Since then other valves have been developed, some of them with as many as eight grids, but all of them operate on the same basic principle.

As soon as it became possible to amplify very weak signals, radio started ahead with giant strides a never looked back.

It was soon discovered that a tri could not only detect the signal, a amplify it, but it could a oscillate. Spark transmitters s disappeared and transmitters us large valves replaced them. Mo lation became possible, where voice and music currents could impressed directly on the outgo

*"Average Australian . . . lazy person."*

carrier. There was now some centive for the man in the st to listen in.

Coming back to receivers, it discovered that, if portion of amplified signal was fed back to grid of a detector valve, furt amplification could be obtained. well-known example of this met is the evergreen Reinartz dete circuit, which is always popu with the rising generation.

Although still only capable of d ing headphones, such small action" receivers began a line development which can be tra through to the late twenties.

There were only two controls this type of set—tuning and re tion—but a certain amount of te nical know-how was required to tain the best results. Clearly a very good proposition for a hou wife, who wants music-while-work!

With the advent of early lo speakers, designers had to prov one—or perhaps, two—more val which could deliver a relativ large amount of electrical power the speaker from the small sig provided by the detector. In vicinity of broadcasting stations

became necessary to fit a volume ol to the receiver to protect ears and loudspeakers from ex- ve output.

th tuning and reaction this three controls in all. However, ner problem was becoming evi- created by all the extra stations h were crowding into the broad- bands about that time.

improve the selectivity of re- rs an RF stage was added ahead ie detector. This required the tion of yet another knob to st, because ganged tuning capaci- were non-existent in those days at least nearly so.

en another problem became rent. Receivers were battery ated, and the addition of valves d a heavy drain on the bat- s, making the operation of "big" rather uneconomical. We must mber that, in those days, the ent requirements of a receiver often reckoned in amps, not amps.

## OTHER VALVE

a result mains power supplies ually replaced the cumbersome expensive batteries. But here another valve—the rectifier! his type of receiver, with an RF , regenerative detector, power ut stage and a mains power sup- with rectifier became very lar, in spite of the number of rols that had to be attended to. forts to simplify the operation of ivers resulted in the elimination eaction. The gain thus lost was e up by a second RF stage. The ng capacitors of the two RF es and the detector were con- ed together, ganged in other ds, simplifying operation enor- sly.

nybody could tune such a set. simply turned the dial to the opriate setting, adjusted the me to suit and ignored the "tone rol" if you didn't know what it for.

he average Australian, being a person, went for this kind of in a big way, valves and com- ents notwithstanding.

## E TRF SET

ntil the advent of superhets this F" arrangement became stand- For those who wanted to im- ve on the musical quality, receiv- with a more elaborate audio am- er and a push-pull power output e were available. Electric gramo- nes had also made their appear- e by this time, and quality radio- ns of the day usually incorpor- this more elaborate audio end. e valves in other words.

s radio stations increased in num- and power, TRF receivers start- to show up their inherent lack selectivity, which, due to con- ictional and theoretical difficul- could not be countered by add- more and more RF stages and ed circuits. Thus the way was ed for the superheterodyne, with inherently high selectivity and of operation.

/e will not go into the theory he superheterodyne here, Tom, ause if you have followed these cles in previous issues, you should w about it all. Sufficient to say such receivers work on the nciple of converting the received nal frequency to a fixed fre- quency in the early stages of the receiver. Further amplification is accomplished in the so-called "inter- mediate frequency" stages, after which the signal passes to a straight- forward detector and audio ampli- fier.

This may seem to be making things rather more complicated, al- though actually it simplifies mat- ters. It is much easier to design efficient tuned circuits for one fixed frequency, than to make two or three tuned circuits operate efficient- ly on a wide range of frequencies.

## THE SUPERHET

Herein lies the advantage of the superhet: there are a minimum of six tuned circuits in a set of usual design, but only two of them have to be adjusted for receiving a station. The rest are adjusted in- itially and have no further role in the actual tuning process. As the two tuning capacitors are ganged, only one control is required for the selection of stations and another one for adjusting the volume. A "tone control" can be added as a purely optional feature.

In most cases, the sets perform well, almost independently of aerial length. A piece of wire, hidden in a suitable position in the room provides ample signal, without com- plications.

By 1933 the superhet was fairly well established as the popular type of receiver and it has kept this position to the present day.

From this year onward two dis- tinct trends can be traced in re- ceiver design, Tom. Toward smal- ler, simpler sets on the one hand, and toward more ambitious sets on the other.

Up to this time popular receiv- ers, mainly five valves, had been housed in console cabinets. This considerably limited their usefulness in the home, because, owing to their size and weight, they could not be moved about, and thus confined the listening area to one room only. Admittedly they could be turned up loud, to fill the whole house with music, or whatever else was on the air, but this method often met con- siderable objection from other occu- pants of the house and/or the neigh- bors.

However, components began to diminish somewhat in size, small speakers became more efficient, en- abling designers to produce receiv- ers which could be moved about the house with considerably less effort than console models.

## TABLE MODELS

Table model radios made their appearance, although still using five valves. This was largely due to the fact that coils were rather in- efficient compared with those of today, and five valves was usually regarded as the minimum usable number.

It was not until the introduction of high gain iron-cored coils that the mantel set, with usually only four valves, could be brought up to the required standards. One of the earliest examples of this type of receiver was the Wireless Weekly Little General, which just about set the standards for the mantel set as we know it today.

**(Continued on Page 91)**

The RADIO MASTER

**RADIOGRAM CHASSIS . . .**

*a great performer on Radio and Records*

**FEATURES:**

Eight valves, world range — Push pull output — Treble and bass boost — Inverse feed-back — R.F. stage — Three position switch for radio and gramophone — Switchpot for volume and power supply — Latest type high gain valves—Straight line edge lit dial in four colours —Moulded escutcheon plate, size 12¼in x 7in—12in speaker, choice of Rola, Jensen or Magnavox — Six months' guarantee — Chassis size: 13in x 8in x 9in high.

**Price £32/10/-**

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**FIVE VALVE RADIOGRAM CHASSIS. PRICE £21/10/-**

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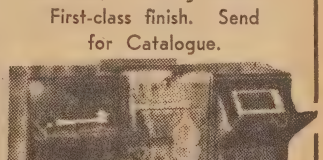

Cocktailgram cabinet as illustrated is 4ft 6in wide and supplied ready to fit your own changer and chassis. Centre section has four pieces of mirror glass (side to side), glass shelf, philenia lamp, automatic switch actu- ated by opening door and chrome plated accessories. Price: £58 plus £1 for packing, freight extra. Also avail- able without glass to suit tape re- corders.

ALL TYPES of THREE SPEED RADIOGRAM UNITS

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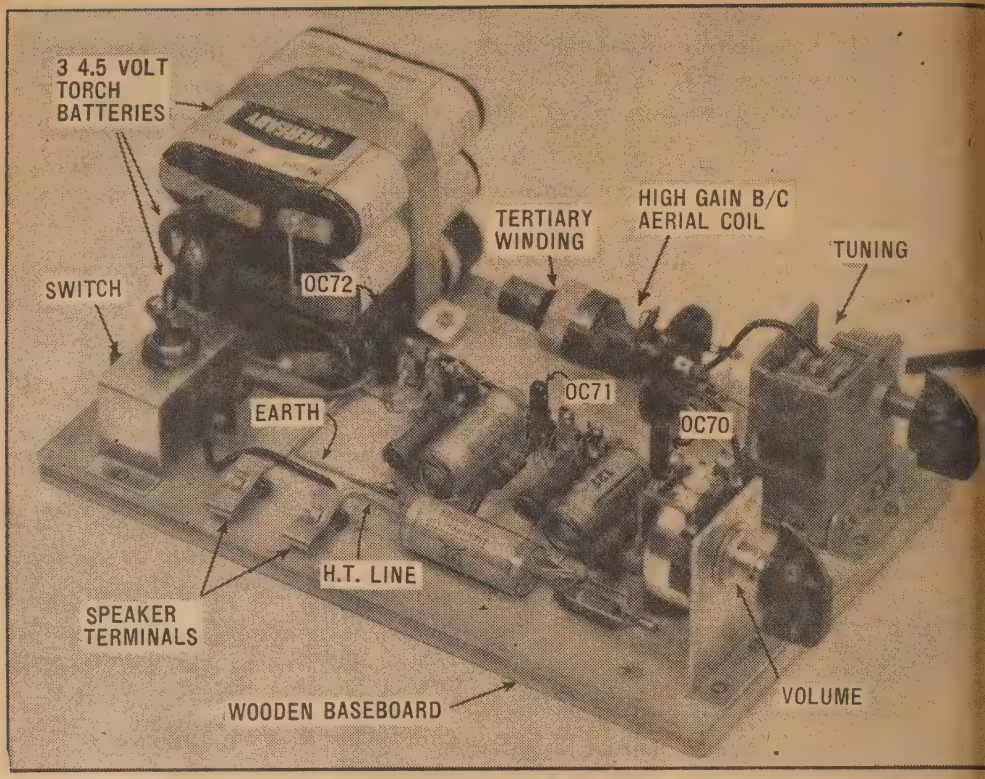



A general view of the receiver, now enlarged to include a detector and two stages of audio amplification. Note that the origin hand-wound solenoid has given place to a high-gain commercial aerial coil, to which a tertiary winding has been added. Th will probably be the last of our "breadboard" transistor sets.

# A 3-STAGE TRANSISTOR SE

This month we take another step in our study of transistor receivers with the addition of a "powe output" stage and the substitution of a more modern type of tuning coil. Very soon we shal be discarding our "breadboard" layout altogether for a metal chassis!

by Neville Williams

FIRST, let's have a look at the tuning coil which you will recognise, from the photographs, as a modern iron-cored type.

In the earlier versions of our little transistor set, we specified a large, hand-wound coil, similar to one we might use in a crystal set. In fact, as we pointed out, it was wound to crystal set specifications.

By doing this, we were able to accomplish several things:

(1) Provide an efficient coil at low cost.

(2) Emphasise the essential similarity between a simple transistor circuit and a crystal set.

(3) Study impedance matching at close quarters.

(4) By means of the numerous tappings effect the best compromise between gain and selectivity for different aerial systems and locations.

However, it is quite obvious that transistor set design cannot forever be wedded to large, hand-wound solenoids and we must, therefore, learn to use coils—and later transformers—of more conventi pattern.

As far as our present set is cerned, the step is a relatively ple one, yet it illustrates well the principles involved.

In substituting a smaller comm cial aerial coil for our large noid, it is quite obvious that efficiency of the one and only ing circuit must be preserved. a very small, low-Q coil were be chosen, both gain and selecti would suffer badly and the set w become virtually useless.

With this in mind, we searc through our box of coils and c across a standard-size aerial

h is credited by the manufac-
r with very high gain (Q-Plus
). The "grid" winding is com-
ely enclosed in iron-dust cups,
e the primary is the usual high
edance type with in-built "top
pling".
milar coils have been avail-
in other brands for some time
our remarks should apply to
n equally well.
hen used with a valve, such
il retains its measured perform-
, because the valve grid im-
s very little loading on the sec-
ary winding. Against this, the
it loading of a transistor is so
re, that it will inevitably wreck
performance of any tuned cir-
across which it is connected.
itherto we have overcome this
culty by tapping the transistor
t circuit across just a few turns
he coil as in figure 1a. This is
of the standard procedures in
sistor practice, but it is of no
stance in our present problem of
pting an untapped coil for the
pose.

## PACITIVE TAPPING

nother possible scheme is illus-
ed in figure 1b, where a fairly
ge value capacitor is connected
series with the normal tuning
acitor. A small portion of the
il signal potential appears across
extra capacitor and can be ap-
d to the transistor input circuit.
t is, in fact, a capacitive divider
tem which achieves much the
ne result as a tapping on the
l.
For our present purpose, the diffi-
ty of this scheme is that the
ltage division varies drastically
th different settings of the main
ning capacitor. On larger sets,
e presence of the series capacitor
uld also upset circuit tracking.
Its most promising application
ould appear to be in IF channels
here the circuit tuning capacit-
ces are fixed values. However, we
e getting ahead of ourselves.
The most practical scheme for our
esent purpose is to provide a low
pedance tertiary winding on the
rial coil, as indicated in figure 1c.
his allows the loading on the
ned circuit to be controlled both
the number of turns on the extra
inding and by its coupling to the
condary.

## OMMON PRACTICE

An examination of provisional
ansistor set designs will show that
is low impedance winding tech-
ique is widely employed. IF trans-
rmers, for example, commonly
ave a tuned primary winding and
n untuned, low impedance second-
y tightly coupled to it.
As might be expected, this leads
a loss of gain and selectivity com-
ared with valve practice and is one
f the current problems of transistor
perhet design. Possible ways out
f the difficulty include the use of
lower intermediate frequency or
ouble-tuned IF transformers hav-
ng a tapped or capacitively-tapped
econdary.
However, once again, we are
ver-reaching ourselves.
To add a tertiary winding to our
ommercial aerial coil, we simply
eached for a likely looking reel of
vire—about 30 B & S enamel—and

# TRANSISTOR RF INPUT CIRCUITS

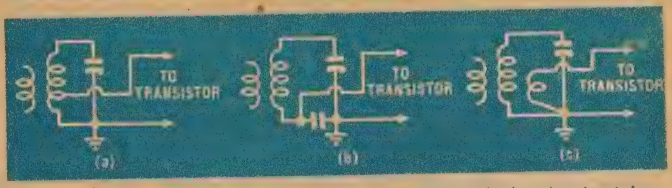



Figure 1: Illustrating three methods by which transistors, with their low input impedance, can be connected to a tuned input circuit. Last month's set used the tapped coil idea (a); this month we have added a tertiary winding as in (c), the turns and coupling of the tertiary winding giving some control over gain and selectivity.

scramble wound 50 turns hard against the core shell and on the opposite end from the primary.

This gave quite good results, although we subsequently achieved a better balance between gain and selectivity by sliding the tertiary winding a little further away from the secondary. In other words, the coupling between the tuned winding and the transistor input was obviously tighter than necessary.

This was duly corrected by putting on a new tertiary winding, hard against the core shell but with only 25 turns instead of the original 50. This was nearer optimum, though perhaps erring now on the side of too little coupling.

Using an earth wire to the water

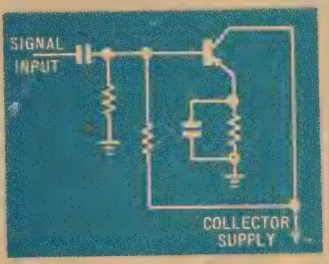



Figure 2: Illustrating the principle of stabilised transistor operation. The base potential is more or less fixed by a resistive divider, while the Emitter returns to earth through a bias resistor and bypass. Variations in Collector current, due to transistor variations or heating effects are offset by bias variations.

tap and an aerial around the picture rail, we were able to receive and separate all local stations in a favorable suburban location. In other locations or with a different aerial, better results might be had with more or fewer tertiary turns but the figure of 25 is likely to be fairly typical.

With open type coils — those not enclosed in iron-dust cups—the tertiary winding may have to be moved a little farther away from the secondary for the same degree of coupling. Without the external cups, the field of the tuned winding is not so rigidly confined and coupling occurs over a greater distance.

In striving for the best results om the lone tuned circuit it would, of course, be helpful to be able to vary the aerial coupling also but this cannot be done in a commercial coil without wrecking it in the process.

The only degree of adjustment we are likely to find is in the capacitive coupling which is often introduced between the "aerial" pin and the "grid" pin. This is an actual wire capacitor in the "Q-Plus" coil but it can alternatively take the form of a wire loop soldered to the aerial pin and cemented around the tuned winding.

Disconnecting this loop or capacitor will reduce the aerial coupling toward the high freqency end of the band and may help matters if only the high frequency stations tend to interfere.

Otherwise, it is a matter of adjusting aerial length for best results, exactly as one does with small regenerative valve sets.

## REGENERATION

And what about regeneration? We gave it another trial, knowing that its successful application to the detector would transform the whole performance of the set. However, it is apparent that these junction type transistors are not equal to the task, due to their poor RF characteristics.

We shall presumably have to await the arrival of types with better RF performance, before we can expect much in the way of reliable regeneration.

In the meantime, the set will be found to perform surprisingly well without regeneration in favorable locations. What is more important, however, it represents an excellent way of getting to know these new members of the electronic family.

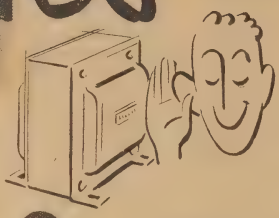
Now let's have a look at the rest of the circuit and the problems involved in achieving higher gain and power output from the audio system. Perhaps it may be as well to talk around things in general before getting down to specific circuit details.

In order to obtain audio power output from a transistor amplifier, it is obviously necessary to feed a proportionately greater amount of battery power into it and in particular into the output stage. Not even a transistor can return something for nothing!

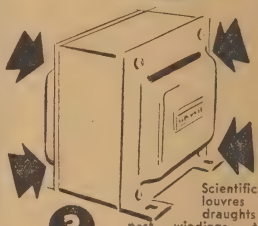
Now the power handling capacity of a transistor is governed largely

# essential features


1 Attractively finished, and coated with grey stoving enamel.

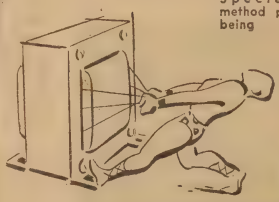


2 Special built-in features have completely eliminated lamination hum.



3 Scientifically placed louvres permit up draughts of cool air past windings, thus ensuring lower working temperature and added safety.

Special anchoring method prevents leads being pulled out.



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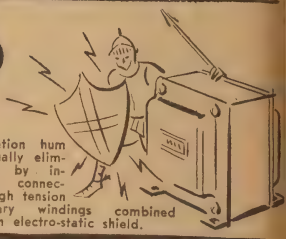
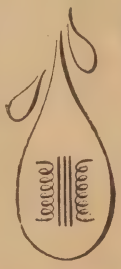


5 Modulation hum is virtually eliminated by inversely connective high tension secondary windings combined with an electro-static shield.



6 Coil is impregnated with special varnish and baked to resist humidity.

7 Available in an unexcelled range of upright and flat types between 40 and 175m. for both radio and step down applications.

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# CIRCUIT OF 3-TRANSISTOR SET

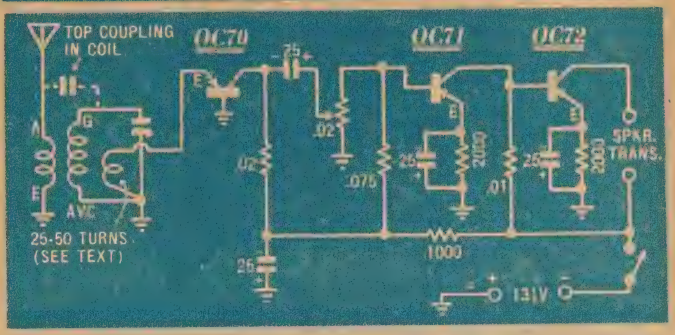


Figure 3: Here is the complete circuit diagram of the 3-stage transistor receiver. Note that the last two stages are direct coupled so that only 10 volts appears across the output transistor. Total current drain of the set is just under 3 milliamps, so that battery life will not be a worry.

e operating temperature of the nal junctions. This is deter- d, in turn, by ambient tempera- conditions and by the natural erature rise which must follow dissipation of electrical energy n the transistor itself.

esent day transistors are ally very temperature sen- and, unfortunately, the tem- ture effects are cumulative in action.

the junction temperature rises, ransistor tends to pass more cur- this produces a further rise mperature and, unless pre- ons are taken in the circuit, the ent tends to rise higher and er, till the transistor is ultim- overloaded.

hat might be termed "safe imum ratings" are therefore de- lant a great deal on circuit and rating conditions. A voltage h might be safe in one equip- t may be dangerous in another, re less attention has been given urrent build-up and cumulative ing effects.

## K VOLTAGES, &c.

hen there is the matter of peak ages and peak currents, which from one circuit to the next which have an important bear- on dissipation, heat rise and so

s we have mentioned earlier, ufacturers' ratings appear to be conservative and very tentative, ably with these very difficulties view. However, their represen- ves agree, more or less un- ially, that considerable liberties be taken with the voltage ratings least . . . "provided dissipation ot exceeded and that the circuit esigned to limit current build-

his is important because one t be prepared to take liberties h the voltage ratings if con- ient circuitry is to be followed l enough power obtained from a gle transistor to operate a loud- aker. At least that appears to be position at the time of writing. igure 2 shows a circuit arrange- nt aimed at giving good stability working conditions. It assumes grounded emitter connection, ich is most frequently used for ction type transistors.

## SE POTENTIAL

he Base is connected to the junc- n of two resistors strung between th and the collector supply line. e bleed current through these istors is normally arranged to be her than the Base current, so that e Base potential is held fairly ble.

The Emitter is returned to earth rough a resistor, bypassed for the nal frequency. Current, flowing the Collector-Emitter-earth circuit oduces a proportionate voltage op across the Emitter bias resistor. The constants of the circuit are rmally proportioned so that the mitter assumes a potential just fficiently positive with respect to ase (in a P-N-P transistor) to pro- ote the designed amount of collec- r current.

If, due to heating or other effects, e collector current tends to rise, en the Emitter goes more negative nd cancels the forward bias in the mitter-Base circuit.

In fact, if one regards the emitter equivalent to cathode, the base equivalent to grid and the collector equivalent to plate, it is possible to see in this a close parallel to the self-bias circuit of an ordinary valve. The chief point of difference is that, whereas the grid of a valve can be held to earth potential with a simple return resistor, the base potential has to be stabilised with a divider network. And of course our "plate" in this case runs with a negative rather than a positive voltage applied.

With this little bit of theory tucked away, we can resume our discussion of "power transistor" problems.

## NEW TYPE

The cheapest and most promising "power" transistor available at the moment appears to be the newly released OC72 — another P-N-P junction type, rather similar in appearance to the OC70 and OC71.

Type OC72 transistors are normally sold as matched pairs with the idea of them being used in class B output service. According to ratings, an output of about 200 milliwatts is available from a class B stage, presumably with an applied collector potential of minus 6 volts.

In the face of such figures, it is not hard to visualise a new bevy of "transistorised" portables, having more power output than their valve equivalents and boasting the combined economy of transistors and B-class operation. Calculations show that such a set would run for about one-tenth the operating cost of a conventional battery portable.

However, for the third time in this article, we are looking a few months ahead of ourselves.

While awaiting the release of miniature B-class transformers, we have taken the chance this month of investigating the possibilities of the OC72 as a single-ended class-A output transistor. The results have been sufficiently good to warrant the manufacturers selling them separately.

Looking at the ratings which, as yet, are only tentative, it would appear that the maximum direct collector voltage is 6.5, though peak and other ratings run up to 13 and even 26 volts.

## "SAFE" VOLTAGE

From what we have been able to gather, however, a collector voltage of 10 is perfectly safe and even higher figures can be used, provided the current cannot "run away" due to heating.

In point of fact, it is not only possible but essential to apply voltages of this order, if linearity is to be preserved and use made of the collector dissipation figure of 45 milliwatts. This, then, is the background to the present circuit design. Let us look at it in detail.

The detector circuit looks a little different from last month, firstly by reason of the tertiary input winding and secondly by reason of the decoupling in the collector supply circuit.

It must be realised that we now have a 3-stage circuit in operation and transistors are no less liable to "motorboating" effects than are valves, when the gain is high and the supply impedance poorly regulated—as would be the case with ageing batteries.

For reasons which are yet to be

## PARTS LIST

| | |
|---|---|
| 1 | Wooden baseboard 8in x 5in x ¾in |
| 1 | Tuning capacitor (.0004 approx.) |
| 1 | High gain aerial coil (see text) |
| 1 | Potentiometer (20,000 ohms) |
| 2 | Control knobs |
| 1 | Off-on switch (SPST) |
| 3 | Three-tag strips |
| 1 | OC70 transistor |
| 1 | OC71 transistor |
| 1 | OC72 transistor |
| 4 | 25mfd 25VW midget electrolytic capacitors |
| 1 | .075 meg. resistor |
| 1 | .02 meg. resistor |
| 1 | .01 meg. resistor |
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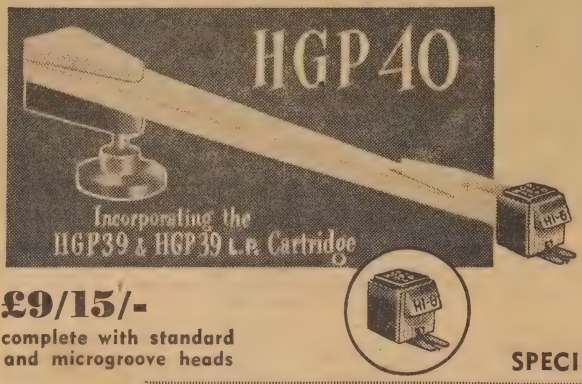


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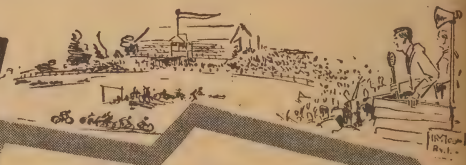

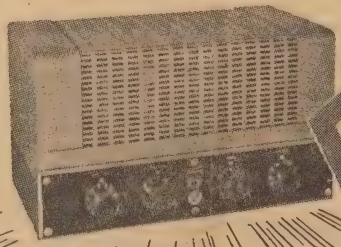

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ssed in detail, it will be noted the supply voltage is shown 3.5, which might seem rather for the OC70 detector. In of fact, the detector draws little current and, since both and emitter are returned to ad for DC purposes, there is chance of the collector cur- "running away".

ain, with a supply voltage of and a total collector circuit ance of 21,000 ohms, even the -circuit current could not rise e 0.65 mA.

e constants in the volume con- circuit have been modified to ve the result explained in con- on with figure 2, namely the lisation of the OC71 base volt- It is noteworthy that the bleed nt is taken from the decoupled on of the supply line, to com- precautions against a low fre- cy instability (i.e. "motorboat- ).

you have any difficulty in ining the 20,000 ohm poten- eter, by the way, a 25,000 ohm can be substituted, provided the d resistor is increased from 0 to 100,000 ohms.

## ARITY

ne Emitter bias resistor for the 1 is specified as 2000 ohms, by- ed by a 25 mfd electrolytic. Note the positive end of the electro- must be earthed. Careful note ld also be taken of the polarity ther electrolytics in the circuit, d as coupling components.

oming to the output circuit of OC71, it would have been pos- e to employ normal resistance acitance coupling, as between the two stages. However, to illus- e an alternative and perfectly ctical scheme, we have specified ect coupling instead.

herefore, the Collector of the 71 is tied directly across to the se of the OC72 output transistor, junction being fed from the ply line through a 10,000-ohm istor.

n practice, the drop across this istor is such that the Collector of OC71 and Base of the OC72 h assume a potential of about nus 4 volts with respect to earth. is is quite in order as far as the 71 is concerned and it also means t the OC72 Base is stabilised very finitely at that figure.

## OLLECTOR CURRENT

With an Emitter bias resistor of 00 ohms for the OC72, the Col- tor current for this latter tran- stor stabilises at about 2 milli- mps. This appeared, on the CRO, give the best balance between ficiency, linearity and output. There was no opportunity to oss-check this figure with other C72 transistors in the same circuit t no special difficulty is anticipated this regard. At the worst, it ould only be necessary to manipu- te the value of the OC72 Emitter as resistor to give a standing cur- nt of about 2 milliamps.

Assuming that there is a poten- al of about 10 volts across the ollector-Emitter circuit of the C72, the input power at 2 milli- mps is therefore 20 milliwatts. This s well below the permissible limit f 45 milliwatts.

There would seem to be no special reason why the supply voltage could not be pushed up a little higher again than the suggested 13.5 so that 11 or 12 volts would appear across the output transistor. However, 13.5 volts is nicely available from three flat torch batteries and we were content to leave it at that.

And what does this mean in terms of audio power? It doesn't sound a lot when quoted in terms of milliwatts but it is enough to be useful.

Into a sensitive—and we repeat "sensitive"—speaker of 5in or larger diameter, it is enough for comfortable listening in a quiet room or situation. It is enough, also, to suggest that, once we know enough about the limitations of transistors like the OC72, we will be able to make quite loud noises with class-A output stages using them.

And the output load? Well, we suggest that you try to get a transformer reflecting 5000 ohms back into the Collector circuit. It could be lower but it shouldn't be much higher than this for optimum results.

## CONSTRUCTIONAL POINTS

So much then for the circuit and its mode of operation. It may be helpful to add a few constructional pointers for those who may wish to duplicate the original set and learn the lessons which it has to teach.

We have already explained the reason for the extra winding on the aerial coil and the factors of gain and selectivity which govern the number of turns and their position on the former. The actual addition of the turns is a very simple process, which can be completed in a few minutes.

Locate a few feet of enamelled wire of about 30 gauge, and clean and tin one end. The gauge is not at all important.

Now slip the coil from its can and locate the "earth" and "AVC" lugs, both of which connect to earth in this particular circuit. Your piece of enamelled wire can be soldered to the inner end of one of these lugs so that it also will go to earth, when the proper connections are made to the coil.

Slip an inch or so of thin spaghetti over the anchored end of the wire, run the wire up past the secondary and wind on the requisite number of turns. Slip another piece of spaghetti over the free end of the wire and hold it in place with a scrap of adhesive tape.

The free end can then pass down through one of the slots at the side of the coil base and out to the external circuit. It does not matter in which direction the turns are wound on.

## COIL CAN

It does not matter a great deal either whether you replace the outer can or not, unless you're concerned about physically protecting the coil. The influence of the can on an enclosed winding is only small and we have no tracking problems with other coils to worry about.

If the coil you choose happens to have the aerial primary above the grid winding instead of below, it will make things rather awkward. It may even be necessary to disconnect all the internal wires so that the extra winding can be added—not a very nice job.

The point is, of course, that the tertiary winding needs to be on the opposite side of the tuned secondary from the aerial primary winding.


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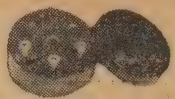

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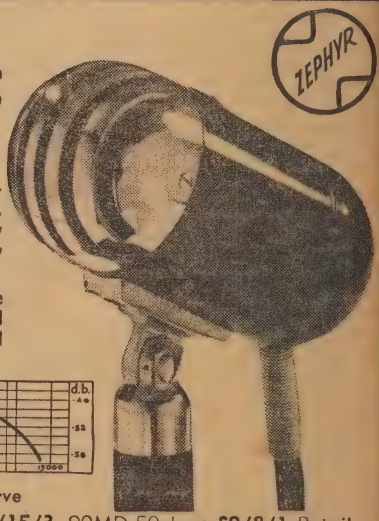


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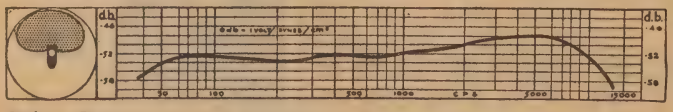


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# MATEUR LICENCE

(Continued from Page 47)

ircuit in step with the modu- g voltage, thus once again vary- its frequency.

fact, it is the ability of the e to change the inductive or citive reactance of the oscillator it which gives it its name of tance modulator.

far we have been talking about ing the oscillator frequency to in FM. But the reactance tube ulator may be applied to an lifier stage following the oscil- to bring about phase modula- or PM, with equal facility.

ere it brings about a time- ie shift in the manner described he first article on FM systems, n because of the modulator e's ability to present an induct- or capacitive reactance to the d circuit of the amplifier.

a high modulator sensitivity equired, it is an advantage to a high-Q circuit with a phase- ulated circuit, because the steep s of the resonance curve will w a large amount of detuning a small amount of phase shift. we have a heavily damped cir- with a wide band-pass charac- stic, we will find it very much der to swing the frequency by desired amount.

## PORTANCE OF Q

t is a good idea, therefore, to some attention to obtaining a table circuit Q—generally accept- as being between 10 and 20—by table selection of component ues, and by light coupling into succeeding stage to avoid too h circuit damping.

Another point worth mentioning that, because of the intimate upling between the modulator and ase modulated valve plate cir- its, a certain amount of AM is ely to take place as well as FM. Although this is small, because e conditions are not very favor- le for AM, it is customary in aborate transmitters to use limit- g stages after the modulated stage eliminate it.

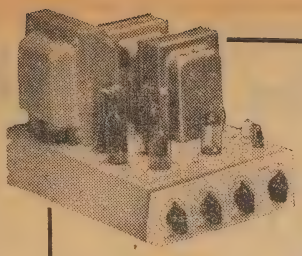
In simpler circuits, however, it usually sufficient to include in e succeeding stages valves which e heavily excited and operated ell into the Class-C region, which nders them insensitive to the nplification of AM waves.

## E-EMPHASIS

In PM, the amount of deviation proportional to the modulating equency as well as its amplitude, s previously explained, and some e-emphasis is required in the odulator circuit to reduce its high- equency response and thus pro- uce a reasonably linear frequency haracteristic.

This practice also avoids exces- ive deviation at the higher fre- uencies.

There are, of course, many other esign factors which will arise when utting actual circuits into opera- ion and other methods of obtain- ng FM and PM. But we have tried o deal with the major items as imply as circumstances allow and f you have obtained a good grasp f them, you should be able to nswer any likely questions on the subject in your examination.

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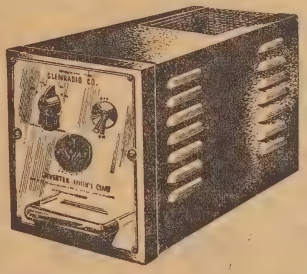

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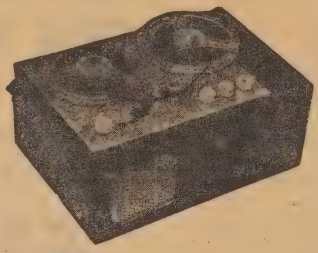

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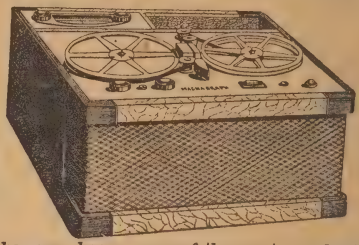

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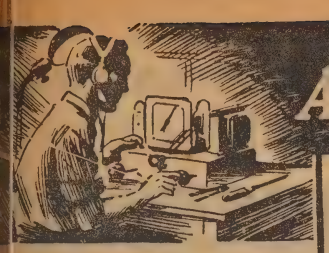
.....

I enclose LARGE self-addressed envelope and 6d in stamps.



# A READER BUILT IT!

**Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.**

## A USEFUL RESISTOR COLOR CODE CALCULATOR

ooking through our past files ve have found an idea forward- d by Mr. S. H. Kearton, 75 Oxley Road, Hawthorn, E2, Melbourne, Vic., which will make very useful device around the radio workshop.

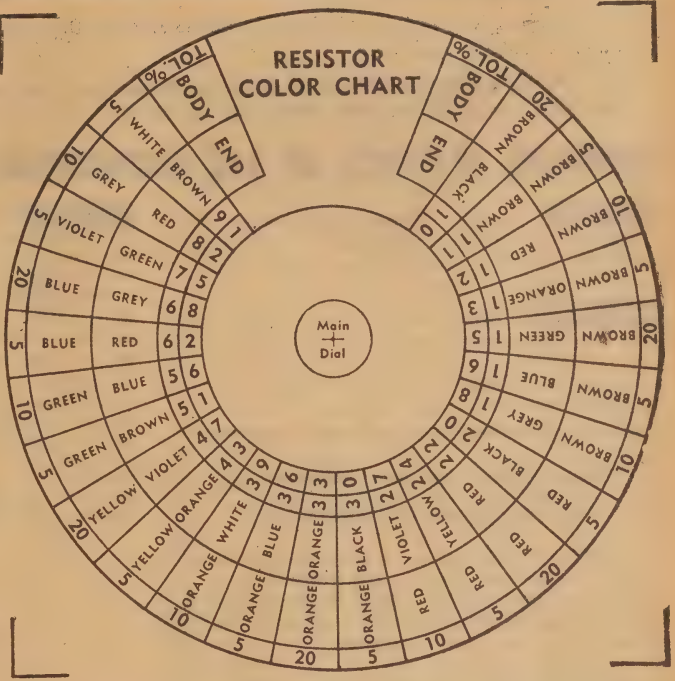
HE idea is for a resistor color code calculator. The calcula- gives all the RMA preferred ues from 10 ohms to 9.1 megohms t the maximum tolerance range, which each value is obtainable. can be used to find the value of unknown coded resistor or to d the color code for a particu- value of resistance.

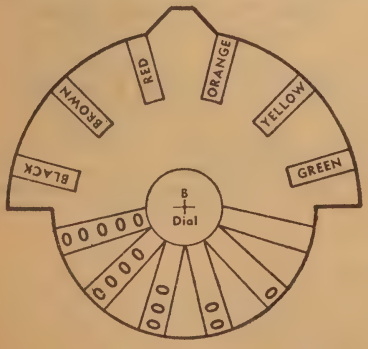
To illustrate the use of the cal- ator, suppose it is required to d the color code of a 39,000 ohm istor.

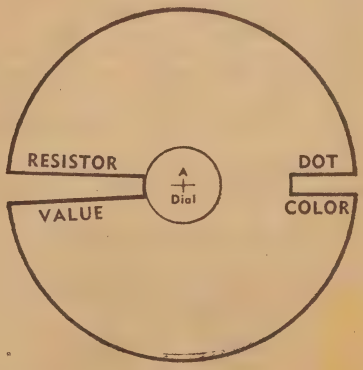
Holding the main dial still, turn top movable dial A until the st two figures, i.e., 39, appear the slot of this dial marked Re- tor Value. To the left of this ll be given the body and end ors, orange and white, in that ier.

Now holding dial A and the main il together move the dial B until e figure becomes 39,000. The lor of the dot will then appear the opening on the right hand ie of dial A, labelled Dot color.

If you are trying to find the lue of a resistor, which is coded d, yellow, brown, look first for



# BOYS! IF YOU ARE TECHNICALLY INCLINED YOUR BIG CHANCE IS HERE . . .

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A career as a Technician-in-Training with the P.M.G.'s Department is full of interest and variety—a job of national importance.

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**THE WORK** Includes installation and maintenance of equipment used in national telecommunications, radio and television. Working conditions and tuition are unsurpassed.

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Male British subjects born not earlier than 31st December, 1937, and not later than 31st December, 1940, may sit for the competitive entrance examination to be held on the 10th September, 1955, in all capital cities and other centres considered necessary.

### Entries close on 20th July, 1955

*The examination subjects are:—*

1. Elementary MATHEMATICS, including Arithmetic, Mensuration, Algebra and Geometry.
2. Elementary SCIENCE, including Physics and Chemistry.
3. ENGLISH, including spelling, essay writing and word meanings.

The standard is equal to Junior Technical or Sub-intermediate.

Successful candidates are eligible for permanency with its benefits of security, promotions and superannuation.

### Talk it over with your parents . . .

If you would like to inspect technical branches of the Post Office, please ring the Public Relations Officer at the G.P.O. in your Capital City.

Applications to sit for the examination close on the 20th July, 1955.

**BENEFITS** In addition to paying your full salary duri the entire period of the course, the Post Office supplies the books and equipment you may require. The excellent sala paid to the trainee is on a progressive scale, according to his ag

*The following additional benefits are enjoyed:—*

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.....

TELEPHONE No. .....

SCHOOL .....

DATE OF BIRTH .....

body color, red on the out- of the main dial. Then to oint where the yellow, for the color, is next to it, now turn slot around till it is opposite combination.

e first two significant figures be shown as 24. Holding the dial and dial A together, ro- the dial B until the color n appears in the opening of A. The value of the resistor ohms will be shown in the slot ced resistance value.

ie widest available tolerance hen shown in line with these he extreme outside of the main in this case, 5 pc.

much for the use of the cal- tor, now to the construction. three dials should be roughly out and pasted on stiff card- d, some weight being placed them during drying to prevent n bending. When these are oughly dry they should be care- y trimmed round the outside s. A hole should then be pierced he centre of each dial. These then assembled together, the n dial on the bottom, the dial ext and the dial A on the top. number of types of fasteners obtainable from hardware stores, ch can be adapted for use as entre pivot or a small nut and could be used.

While the various divisions on the s have been printed with the ors of the code, a more easily d calculator is obtained if these filled in with the actual colors, it will be found that the time nt will be well repaid.

# HERE'S YOUR ANSWER TOM!

(Continued from Page 79)

Even though valves, components and cabinets have changed during the years, the circuit employed in such mantel receivers has remained largely the same as it was fifteen years ago: a simple superhet.

Looking back again to 1933, we can see another line of development, that of the big set.

## RADIOGRAMS

A typical radiogram of the time was the well-known Wireless Weekly "1933 Standard", featuring an RF stage, a highly selective IF channel, a detector, phase inverter, and a push-pull output stage.

Combined later with a record player and a bigger and better speaker than was usual on table model receivers, this type of set became very popular.

With the postwar improvement in records, pickups and loudspeakers, this line of development has resulted in the design of high quality audio amplifiers with five, six or even more valves. According to the desires of the listener, a pickup is connected to this amplifier, or else a tuner, to provide a variety of programs from radio or records.

As often as not, the tuner is designed to give high fidelity reception of the local stations.

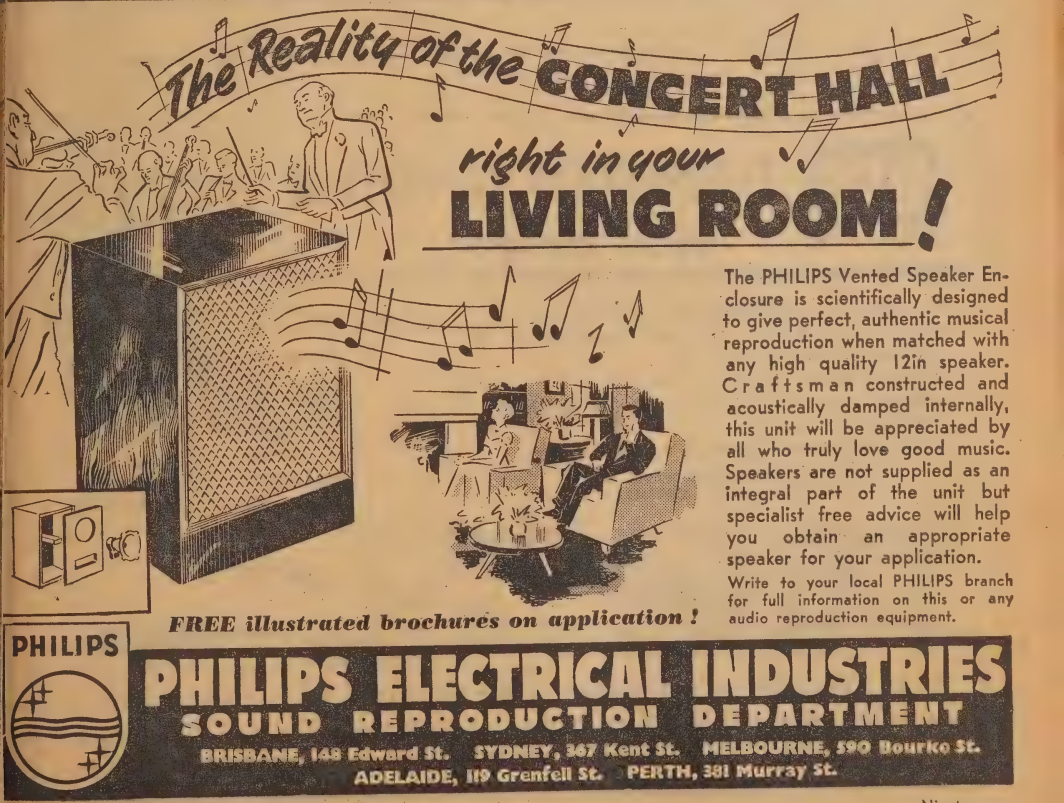
Our Playmaster series of amplifiers and tuners serve as an excellent example of this trend and quite a few comercial manufacturers are coming to light these days with de luxe receivers.

However, these sets require considerable theoretical knowledge of record reproduction, recording curves and suchlike matters and, naturally, can only appeal to people who go to the trouble of learning all about it. And not many people are prepared to do that.

So there it is, Tom. Radio sets aren't designed in this country to squeeze the last ounce of performance from two or three valves. Even run-of-the-mill mantel sets use enough valves to ensure easy, non-critical operation

On the other hand, "big" sets make no pretence at being anything else. They use as many valves and components as the designer thinks necessary to achieve his requirements—wide range, high power, accurate tone compensation and so on.

But, for all that, the experimenter can still get a lot of fun from his one and two valve sets, adjusting and fiddling to get from them the last ounce of performance.


The PHILIPS Vented Speaker Enclosure is scientifically designed to give perfect, authentic musical reproduction when matched with any high quality 12in speaker. Craftsman constructed and acoustically damped internally, this unit will be appreciated by all who truly love good music. Speakers are not supplied as an integral part of the unit but specialist free advice will help you obtain an appropriate speaker for your application.

Write to your local PHILIPS branch for full information on this or any audio reproduction equipment.

*FREE illustrated brochures on application!*

PHILIPS

PHILIPS ELECTRICAL INDUSTRIES
SOUND REPRODUCTION DEPARTMENT
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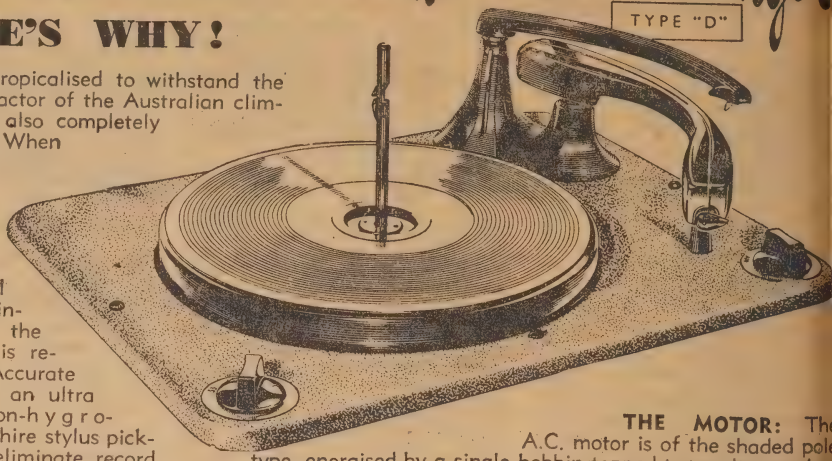
ADELAIDE, 119 Grenfell St. PERTH, 381 Murray St.

# Turn to the Plessey Automatic Record Changer

## HERE'S WHY!




**THE UNIT:** Tropicalised to withstand the heat/humidity factor of the Australian climate the unit is also completely self-contained. When playing 7in 45rpm large centre hole records, (i.e. where optional size hole is not incorporated), the spider adaptor is recommended. Accurate mechanism and an ultra lightweight, non-hygroscopic, dual sapphire stylus pick-up combine to eliminate record wear. Plays 8 or 10 records (78, 45 or 33 1/3 r.p.m.) in continuous recital. Mixing is possible with records of same speeds.

**THE MOTOR:** The A.C. motor is of the shaded pole type, energised by a single bobbin tapped to a voltage selector board, allowing operation on voltage ranges varying from 200 to 250 volts on 50 cycle A.C. mains. Drive from the motor three-step pulley is transmitted to the turntable rim via a rubber-cushioned idler pulley.

**UNITED RADIO DISTRIBUTORS PTY. LTD., 175 Phillip St., Sydney. BL3954**

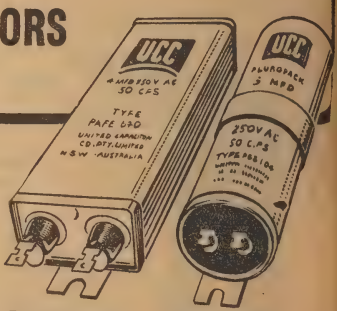
---

UCC

## FLUORESCENT CAPACITORS *last longer!*

- Designed for CONTINUOUS operation.
- Made from purest materials, hermetically sealed for longer life.
- Rigidly tested and inspected.
- Wide range of standard ratings — special ratings to order.
- Available in rectangular or cylindrical types.

*For trouble-free operation specify and fit UCC Fluorescent Capacitors.*




**Rectangular Type PAF** **"Fluropack" Type PB**

UCC **Capacitors** *for every application*

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FOR FURTHER INFORMATION CONTACT:-

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**ADELAIDE:** Stephen & Co., 83 Grenfell Street.
**BRISBANE:** Tecnico Ltd., 103 Albert Street.
**PERTH:** O. F. Gamble, 384 Murray Street.
**N.Z.:** H. W. Clarke (N.Z.) Ltd., 42 Cable Street, Wellington.

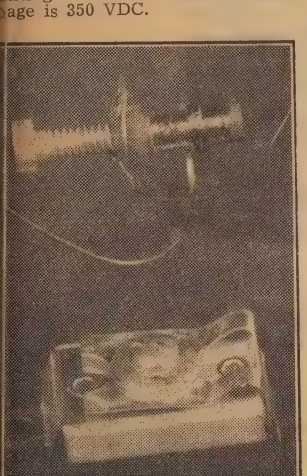
# TRADE REVIEWS AND RELEASES

## ew trimmers om Ducon

**f special interest to designers high-frequency equipment and particular television tuners is e release from Ducon Conden- r Ltd., of a chassis-mounting ceramic trimmer.**

E trimmers are available in hree capacitance ranges of 3, 5, 8pF maximum. Adjustment of trimmer is by movement of the w into the silvered ceramic .

he trimmers require only a single for mounting, a spring washer ce serving to hold the trimmer place as well as locking the isting screw. Rated working age is 350 VDC.



Two of the new Ducon trimmers, the screw type above and, below, the silver-plated compression type.

Also released by the same com- ny is a compression type mica immer. The metal parts of the unit e silver-plated and the adjusting rew thread is of fine pitch to cilitate accurate adjustment with- it backlash. The front earthy plate taken around to the rear of the rew to act as a tensioning device. wo capacitance ranges are avail- ble, 1.5—15 and 3—55 pF, and electric type mica is used in the onstruction of these trimmers.

Wire type trimmers, consisting of coil of wire around and in close ontact with an insulated central onductor, are also available for eceiver manufacturers.

Supplies of these components will e available through normal trade hannels. Detailed information can e obtained from the manufacturers: Ducon Condenser Ltd., 887-895 Bourke St., Waterloo, NSW.

# BJ ARM GIVES GOOD TRACKING

This photograph clearly shows the general construction of the new high performance BJ arm. An adaptor is supplied for the Acos GP39 head.

**For those enthusiasts interested in high fidelity equipment there is now available on the Australian market a pickup arm having a new approach to the problems of obtaining satisfactory tracking for playback arms.**

THIS unit, known as the BJ arm, comprises two arms of different lengths mechanically coupled to keep the head closely aligned to the original cutter position. These arms are light alloy tubes pivoted on precision needle bearings to give a featherweight movement together with a high factor of rigidity.

It is possible to use a large number of standard cartridges with this arm and the new patented counterweight assembly allows setting of the optimum stylus pressures without interference to the tracking weight.

The record wear which will occur with this pickup arm will be low as a result of its closer tracking and its less tendency to groove climbing; stylus wear should also be reduced.

On test a definite improvement in quality was observed as compared with a standard arm, particularly on the centre grooves where departure from ideal tracking is most serious.

An independent check made on the arm showed a tracking error of less than plus and minus one degree on a 12in record, provided the tone arm pedestal was positioned correctly. This compares with a figure of 3 to 4 deg. for a standard 8in arm.

A template is supplied with the unit so that the user can do this accurately.

The workmanship of the unit is good and the general construction is in keeping with other quality equipment.

Should adjustment of the bearings be necessary this can be carried out, as each bearing is of the screw and a lock nut type.

Australian distributors for these arms are Simon Gray (Radio Division), Elizabeth St., Melbourne, and Messrs. Electronics Australia Pty. Ltd., of Perth.

# TWO JUNCTION TRANSISTORS FROM STC

NOW available in quantity from Standard Telephones and Cables Pty. Ltd. is the type 3X/302N Junction Transistor.

These transistors are hermetically sealed and have very good mechanical protection, the outside being a metal can. Collector dissipation for this type is 200 milliwatts, and the main application is for low power audio and radio frequency amplification.

The manufacturers give the maximum power output for audio applications as .5 watt for a class B push-pull pair. Further details can be obtained from the manufacturers.

---

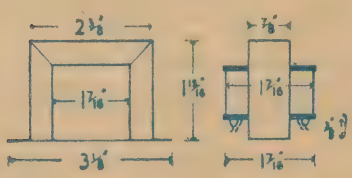
IT is regretted that on page 95 of the last issue the price of the book, Simple Electronic Musical Instruments For The Constructor, by Alan Douglas, was given as 6/8 instead of 8/9, the correct price.

# R.C.S. release details of... CHOKES ... TRANSFORMERS

**Here are full details of types available in R.C.S. filter chokes, audio chokes and transformers, filament and auto transformers, speaker transformers and speaker replacement windings. It is suggested that these details be kept for reference. These R.C.S. components are both designed and manufactured in the light of latest findings in the field of electronics. Brackets are of aluminium and bobbins are of moulded polystyrene.**


## FILTER CHOKES AND SPEAKER TRANSFORMERS

Size: Core Section ¾in x ¾in 10 watts.
o/all sizes 2¼in L x 2in H x 1¼in W.




### FILTER CHOKES

| | Retail Price |
|---|---|
| TC 66 14/60 | 10/6 |
| TC 66 Windings only | 6/6 |

### SPEAKER TRANSFORMERS

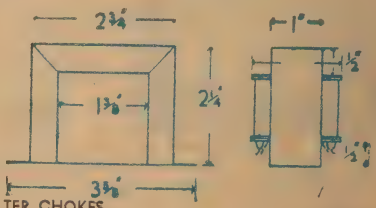
| Type | Primary Ohm | Voice Coil Ohm | |
|---|---|---|---|
| TS 23 Single Triode | 3500 | 2.3 | 16/- |
| TS 24 Single Triode | 3500 | 3.9 | 16/- |
| TS 25 P/P Triode | 3500 | 2.3 | 16/- |
| TS 26 P/P Triode | 3500 | 3.9 | 16/- |
| TS 27 Single Pentode | 5000 | 2.3 | 16/- |
| TS 28 Single Pentode | 5000 | 3.9 | 16/- |
| TS 29 P/P Pentode | 5000 | 2.3 | 16/- |
| TS 30 P/P Pentode | 5000 | 3.9 | 16/- |

### SPEAKER REPLACEMENT WINDINGS

| | | | |
|---|---|---|---|
| F 132 Single Triode | 3500 | 2.3 | 7/- |
| F 133 Single Triode | 3500 | 3.9 | 7/- |
| F 134 P/P Triode | 3500 | 2.3 | 7/- |
| F 135 P/P Triode | 3500 | 3.9 | 7/- |
| F 136 Single Pentode | 5000 | 2.3 | 7/- |
| F 137 Single Pentode | 5000 | 3.9 | 7/- |
| F 138 P/P Pentode | 5000 | 2.3 | 7/- |
| F 139 P/P Pentode | 5000 | 3.9 | 7/- |

## CHOKES AND TRANSFORMERS

Size: Core Section 7/8in x 7/8in 15 watts
o/all sizes 2¾in L x 2in H x 1¾in W.




### FILTER CHOKES

| | Retail Price |
|---|---|
| TC 60 100 M/A 30 H | 17/8 |
| TC 70 75 M/A 50 H | 18/- |
| TC 65 50 M/A 30 H | 16/4 |
| TC 58 L/T 3 amp 50 M/H Vib. | 17/6 |

### AUDIO TRANSFORMERS

| | |
|---|---|
| TB 42 A Class 3 to 1 | 27/- |
| TB 43 A Class p/p 3 to 1 | 28/- |
| TB 44 B Class p/p 1½ to 1 | 27/- |

### AUDIO CHOKES

| | |
|---|---|
| TA 4 100 H 1000 ohms | 21/- |

### FILAMENT AND AUTO TRANSFORMERS

| | |
|---|---|
| TP 53 2.5 v 5 amp | 23/- |
| TP 54 4.0 v 3 amp | 23/- |
| TP 55 6.3 v 3 amp 15 watt | 20/6 |
| TP 80 6.3 v 4 v and 2.5 auto | 18/- |
| TP 56 12.0 v 1.5 amp | 23/- |
| TP 57 18.0 v 1.0 amp | 23/- |
| TP 58 240 v 0.5 amp | 23/- |

**R.C.S. RADIO PTY. LTD., 651 FOREST RD., BEXLEY N.S.W.**

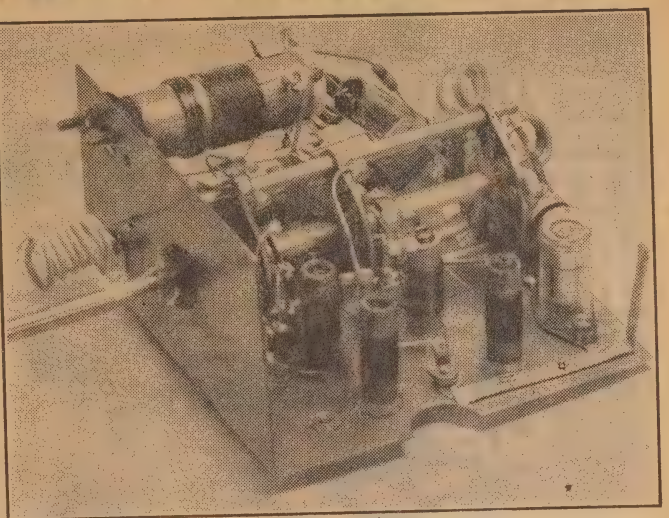
# .W DISTRIBUTION SET-UP FOR KINGSLEY PRODUCTS

has been announced that Jcoby, Mitchell & Co. Pty. Ltd. ve been appointed NSW ents for Kingsley coils and components.

s proposed to carry stocks of he Kingsley products to obviate difficulty in obtaining supplies SW.

ong the items stocked will be bandspread coil units, which been featured in past R & H its. The coil unit above is spread type KBSI, which covers ranges 14.8-15.6 Mc/s; 11.5-Mc/s; 9.35-9.9 Mc/s; and the al broadcast band. Also avail- is the type KBS2, which covers same ranges, but includes an stage. Both units have a ophone position on the switch well as a set of contacts for ching a dial lamp to indicate gramophone position.

e use of this type of coil unit inates the most intricate part e receiver wiring for the home tructor and is capable of excel- results.



The Kingsley type KBSI Band Spead coil unit.

# X-ACTO MODELLING KIT

**Now available to the home obbyist is a complete set of iniature tools able to tackle he most intricate and varied asks likely to be encountered in the home workshop.**

THESE tools are available either as a complete kit or as separate tools. The largest kit, illustrated below, includes chisels, knifes, gouges routers, punches, saws, a spokeshave, plane, balsa stripper, and sanding block.

A special feature of the tools is that the various cutting blades, etc., are removable from their handles to permit the use of one handle for several blades. The kit is most attractively presented and each tool has its own space in the box.

Also available at 5/11 is a very comprehensive instruction book giving details of the various handicrafts for which these tools can be used.

The Burlington kit sells through retail stores for £7/19/6, the sole Australian agents being Jacoby, Mitchell & Co. Ltd., 477 Kent St., Sydney.

The Burlington home hobbyist kit, which includes a very wide range of tools for model ship, aircraft and similiar small scale modelling work.

## GARRARD TRANSCRIPTION MOTOR

THE Garrard Engineering and Manufacturing Co. Ltd. have pointed out two errors in the description of the Garrard Transcription Motor, Model 301, on page 87 of the May issue.

The correct value of maximum wow is 0.2% and 0.05% flutter.

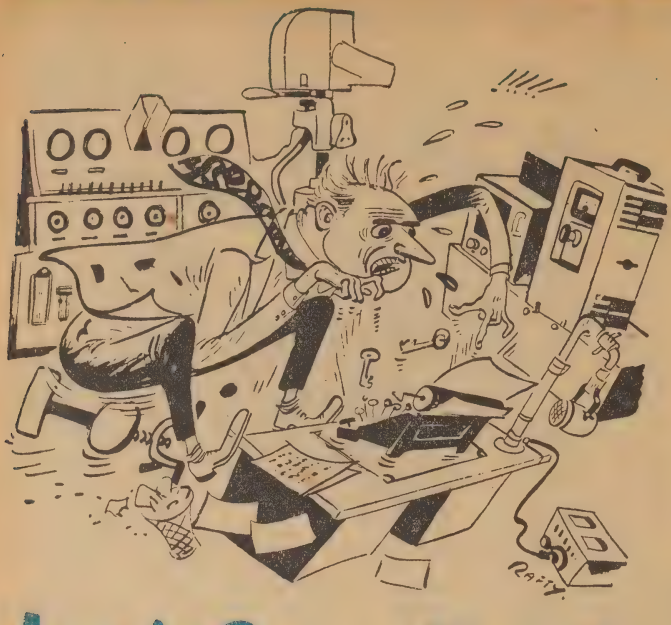
Secondly, it was found by the manufacturers that it was not necessary to supply both 50 and 60 cycle motor pulleys, and, therefore, either is supplied as initial equipment to the order specifications.

## PLASTIC TAPES

A RECENT circular to hand from Messrs. Wm. J. McLellan emphasises the many uses to which some of the current types of plastic tapes can be put.

For example, the No. 33 tape can be used for such tasks as taping oil lines, masking during electroplating, taping overhead or buried cables, &c.

Type 27 tape has a glass-cloth backing and thermosetting adhesive, while No. 16 tape is cotton backed and treated to be chemically inert.



# Let's Buy An Argument

**If one had to think about a heading, we might do worse than call this "Further-light-on-the-subject" month. We say this because one of our readers has produced some further light (or something) on the subject of multiple feedback loops in audio amplifiers. You might agree or you might want to argue. That's up to you!**

HIS letter is reproduced on the opposite page and I suggest you read it through, so that you'll know what I'm talking about.

Now let me tell you the story behind this particular letter:

The writer is well known to me, and, as is obvious from the letter has access to conventional studio type test equipment.

Some months ago, when all the hubble-bubble started about the Ultra-Linear circuit, we got to talking about the subject.

"Was it really as good," he wanted to know, "as some writers claimed?"

"Did it really warrant replanning a new amplifier he was in the process of building?"

## "TRY IT YOURSELF"

To cut a long story short, we passed over to him an early mock-up version of the "Playmaster Nine", described in the May issue. It had 6M5's in the output stage at the time and a different voltage amplifier but his test figures nevertheless indicated the general performance to be expected from it.

"Overload" was reckoned to occur with 9.6 watts in the secondary at 5% total distortion. This fell to 2.3% at 8.93 watts and to 0.17% at 7.7 watts.

At about 5 watts, his figures showed the distortion to be hovering around the 0.1% mark and getting lower as the power output was reduced However, these still lower values were rather uncertain due to the influence of noise components and the limitations of the test equipment itself.

Our friend was quite impressed on getting such figures from what was essentially a very simple amplifier However, he felt that it should be possible to do as well, if not better, with multiple feedback loops around ordinary pentodes. He decided to "give it a go", anyway.

by Neville Williams

In deciding to do so, he had seve motives:—

(1) To prove the point of his co tention.

(2) To avoid any loss of pow output which the U/L circuit mi involve.

(3) To make use of two mediu slope output valves and a conve tional high-grade output transfo mer, which he already had on ha

Well, the amplifier was duly bu and, I must say, built very well. wouldn't have looked out of pla in the most orderly array of stu gear.

But the test results were a d ferent story—or at least they f short of expectations.

## TREBLE DISTORTION?

For all his care in constructi and testing, he could not match t performance of the simpler circu Furthermore, the amplifier exhibit an unnatural distortion content—other "foreign" voltage—when test at high audio frequencies. Why?

At this stage, we suggested th his problem might have somethi to do with "ringing" and alli effects in the supersonic regio If there was a rising respon somewhere up top, it might a centuate the high order harmon sufficiently for the test equipme to register the difference.

Did he have access to square-wa testing gear?

No, he didn't.

Our own generator happened be "sick" at the time but we rec oned that it might still be goo enough to show up any such peculi effects. Perhaps he'd like to give a run.

Well, we fed the amplifier into proper resistive load, switched it and fed in some square waves between 5 and 10 Kc.

## BAD RINGING

I don't think I've ever seen an where a worse example of ringin The diagram overleaf is a tracin we made directly from the CRO fac As you can see, the ringing con tinues right across each flat top an even distorts the sides of the trac

We'd seen the effect often enou to guess at the cause—too muc feedback!

However, without changing any thing, we switched back to sine wav and the pattern resumed its per fectly regular shape, without a hi of trouble of any kind. Now check the frequency response:—

Level over the bass end. Level the centre. Still level up into e supersonic range. Then sud-enly, Wow! A huge peak at about ) Kc!

Actually, it was just where we xpected it would be, from count-ig the ringing pips on the square ave. Our friend was dismayed nd went to work with the soldering on on the spot.

He tried using one feedback loop, nen two loops again. He tried arious bypass capacitors across the eedback resistor but with only nediocre results. The amplifier imply would not take feedback of 0 db and upwards without "ringing" adly on square waves.

Then he cut the feedback down o 15 db and tried again. This time, with the proper feedback bypass apacitor, the ringing virtually van-shed. Nor did it seem to matter very much whether it was applied n one or in two loops—just as long as it didn't exceed 15 odd db.

## FURTHER TEST

But how would this affect distor-ion? Would the measured results now be inferior, due to the reduc-tion in feedback?

Our friend went away, set up his test gear again, and ran out a com-plete new set of figures at one sit-ting. The figures are there, for you to see, exactly as he wrote them down.

In every case, the reading with a single feedback loop is seen to be better than using an equivalent amount of feedback in two loops. The reduction in feedback has de-graded the middle frequency per-formance slightly but has checked the disproportionate rise in distor-tion at the top end.

It is also apparent that, while the figures are quite low, they do not compare with those quoted earlier for an equivalent Ultra-Linear ampli-fier. The difference, though mar-ginal, was enough to set our friend thinking along the lines of selling his present transformer and re-investing in a new, tapped job.

## WHAT CONCLUSIONS?

Which, of course, raises the ques-tion of whether he (or we) should jump to any conclusions based on a single set of figures. Perhaps we shouldn't but we would be equally foolish to ignore them completely. At least we should be warned by them in certain respects:—

(1) Multiple feedback loops don't necessarily improve performance, no matter how clever they may look on paper.

(2) With currently available high-fidelity transformers, phase shift and allied problems may well make it unwise to use more than about 15 db feedback around the output stage, especially with pentodes or tetrodes. Severe supersonic peaks and ringing can result.

(3) Ringing effects are not neces-sarily eliminated by breaking up large degrees of feedback into mul-tiple loops.

(4) In terms of distortion, overall response and ringing, triode and Ultra-Linear amplifiers conform fair-ly closely but it is not easy to dupli-cate either with ordinary pentode-feedback circuits.

These four statements are rather

# RE MULTIPLE FEEDBACK LOOPS

*Dear Sir,*

*The writer was particularly in-terested to read C.H.'s letter in the May issue of "Let's Buy an Argument", having also tackled the problem of providing equiva-lent results to partial triode oper-ation without recourse to a tapped output transformer.*

*The use of two feedback loops appeared to be the logical approach and the method of application is shown in the circuit diagram attached hereto.*

*Type 12AT7 was selected as the phase inverter, design procedure for providing balanced drive being derived from an article by Scroggie, on self balancing inver-ters, in the July, 1945, issue of Wireless World. Due allowance was made for a measured 7db loss in gain, occasioned by omission of the cathode bypass on the second half of the tube.*

*The circuit was made as simple as possible, and with the excep-tion of the output stage, cathodes were not bypassed, to avoid phase shift at low frequencies.*

*The degree of feedback in the plate to cathode loop was set at 7db, and that in the "overall" loop at 13db, resulting in a total gain reduction of 20db. Similarly, 20db gain reduction was employ-ed in the tests with a single "overall" feedback loop. In this connection and with the "no-feedback" tests, the cathodes of the second stage were joined.*

*However, even with phasing correction; 10 kc/s square wave tests indicated very severe ring-ing, and it was necessary to re-duce the total feedback in both cases of single and dual loops to 15-16db; in the latter case, the overall loop was reduced to 9db.*

*In the final analysis the ampli-fier was essentially level in out-put between 13c/s and 130c/s, but the CRO pattern for the dual loop was still inferior to that of the single overall loop.*

*RMS sum distortion measure-ments were carried out for all conditions at mid, low and high frequencies for outputs of 8 watts, 1db below 8 watts and at 1 watt. These results are shown in the accompanying table and will serve to compare the merits of the various types of feedback applied.*

*It will be seen that with plate-cathode feedback, the distortion at the higher frequencies does not fall in step with the gain reduc-tion and I have concluded that the coupling between primary halves of the output transformer is not as tight as one would expect with this so called "Williamson type" transformer, of well known manufacture.*

*The general impression indi-cates that the single overall loop has better distortion characteris-tics than the dual system.*

*It follows therefore that no advantage is gained by employing multiple loops, unless the trans-former used has particularly good characteristics; and even then it is debatable whether results would warrant the additional cost and elaboration.*

*The experiment at least served to emphasise the necessity for applying feedback in a discrimin-ate manner, irrespective of the type of circuit used. Mr. Moyle made mention of this in his article on Playmaster Ultra-linear amplifiers, in the May issue of Radio, TV & Hobbies.*

*It is not intended to imply that the square wave tests employed are necessary or essential when checking amplifier performance, but good results from this test would be expected to give a mar-gin of safety when the amplifier is called upon to reproduce the various transients associated with program material.*

*Yours faithfully (W.P.).*

## R.M.S. SUM DISTORTION

| Frequency | No. F/B | 7db plate To cath. F/B | 20db in 2F/B loops | 20db single Overall loop | 15db in 2F/B loops | 15db single Overall loop |
|---|---|---|---|---|---|---|
| | | (8 WATTS IN 15-OHM LOAD) | | | | |
| 1000cs | 2.3 | 1.8 | 0.5 | 0.4 | 0.7 | 0.5 |
| 50cs | 4.0 | 2.5 | 0.65 | 0.6 | — | 0.9 |
| 7.5Kc | 4.0 | 4.75 | 1.9 | 1.25 | 2.2 | 1.0 |
| 10Kc | — | — | 3.5 | 2.7 | 4.0 | 1.5 |
| | | (1db. BELOW 8 WATTS IN 15-OHM LOAD) | | | | |
| 1000cs | 2.1 | 1.5 | 0.4 | 0.28 | 0.6 | 0.45 |
| 50cs | 4.0 | 2.2 | 0.6 | 0.5 | — | 0.8 |
| 7.5Kc | 3.0 | 4.3 | 1.4 | 0.7 | 1.8 | 0.75 |
| 10Kc | — | — | 2.3 | 1.2 | 2.9 | 1.2 |
| | | (1 WATT IN 15-OHM LOAD) | | | | |
| 1000cs | 0.85 | 0.45 | 0.14 | 0.13 | 0.2 | 0.18 |
| 50cs | 1.4 | 0.8 | 0.45 | 0.4 | — | 0.5 |
| 7.5Kc | 1.3 | 1.4 | 0.4 | 0.25 | 0.5 | 0.2 |
| 10Kc | — | — | 0.55 | 0.27 | 0.65 | 0.29 |
| | | (VOLTAGE EQUIV. TO 1db BELOW 8 WATTS BUT 50-OHM LOAD) * * | | | | |
| 7.5Kc | — | — | 0.3 | 0.23 | | |

* Phase correction applied

** Applied to simulate the loading of the amplifier by a loudspeaker at 7.5Kc. This of course does not take into account the reactive component and may therefore not be conclusive.

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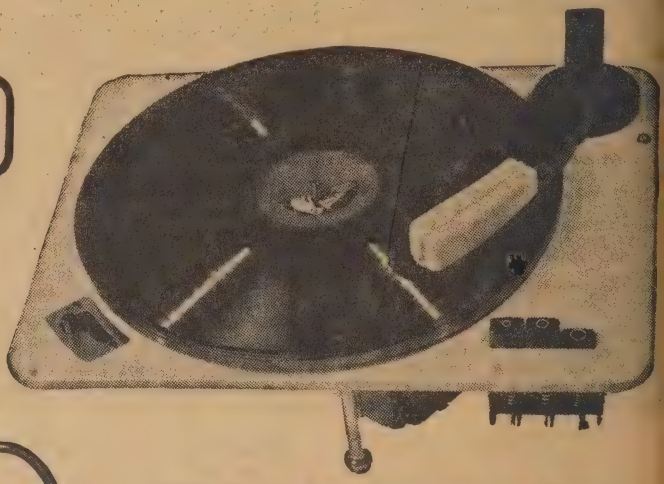

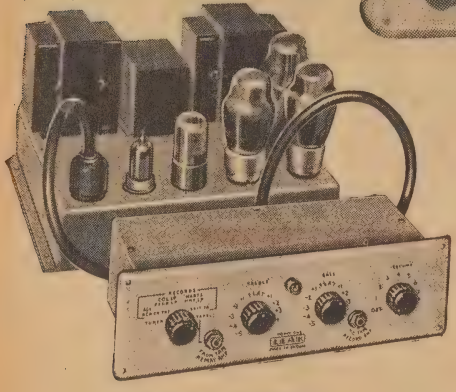

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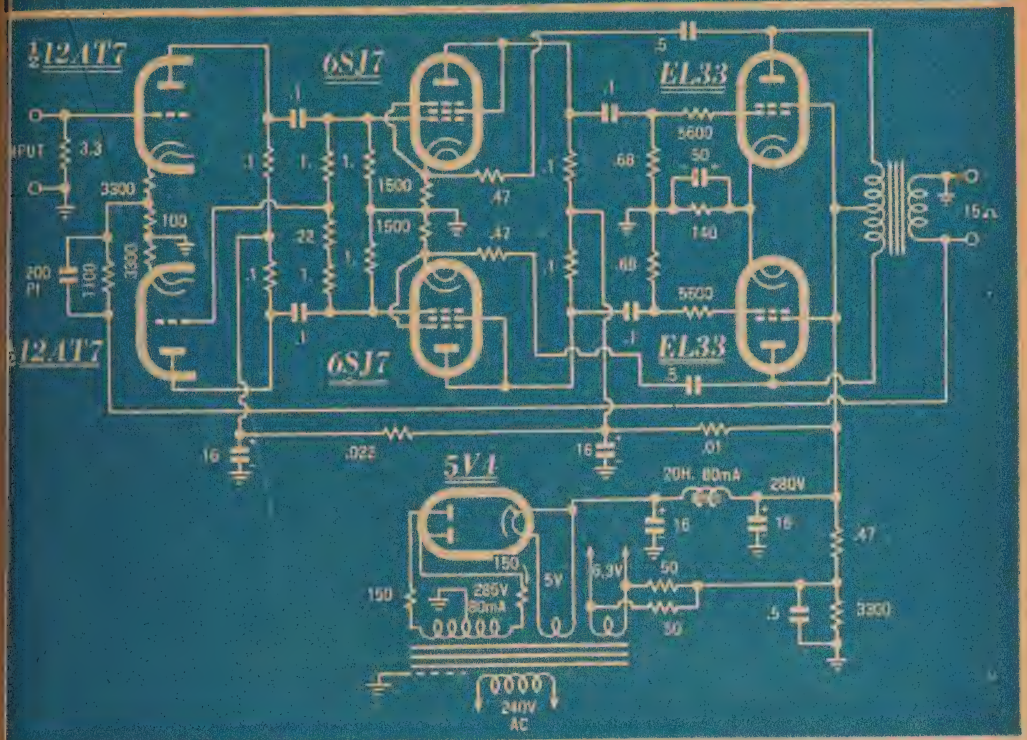



One of our readers tried hard with this circuit to equal the results from an Ultra-Linear amplifier—but in vain. Was he unlucky, did he do something wrong or was he trying to achieve the impossible?

sweeping, of course, and deliberately so for the sake of argument. However, they probably contain a good deal of truth when applied to amplifiers as we now know them.

But, you say, what does it mean in practice?

Is it logical to pick and choose between amplifiers when they have only a fraction of a percent distortion anyway?

What possible influence on listening can result from a response peak far outside the audible range?

How can one possibly be aware of "ringing" effects up around 80 Kc?

## NO READY ANSWER

In American currency, those are all 64-dollar questions, to which there is no ready and proven answer. The best that can be done is to have folk listen carefully to amplifiers with and without these effects and record their impressions of them.

Up till quite recently, little notice was taken of an amplifier's behavior in the supersonic region or with high frequency square-wave input. It probably didn't matter a great deal either, because the records, speakers and pickups available contributed enough distortion of their own to mask any minor effects in the amplifier.

And it still probably doesn't matter in the average set-up for the very same reason.

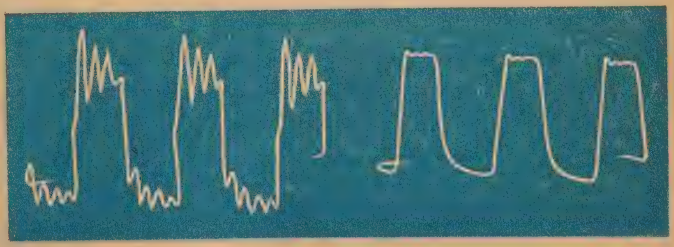
But, nowadays, there are plenty of record enthusiasts who are prepared to spend £30 or more on a speaker, something like the same amount on a motor, another big wad on a hand-made pickup, with carefully selected records to suit. **With ancillary equipment of such quality, a closer look at the amplifier equipment may be warranted.** In fact, that is precisely what is happening at the moment.

While there is ample room for unconscious self-delusion, there is a feeling abroad that these non-peaky, non-ringing, very low distortion amplifiers do sound "cleaner" in the long run than others of more routine design. The most authoritative impressions are as vague as that but they probably mean something.

But how can the ear be sensitive to things that happen in the supersonic region? To ringing, for example, at the aforementioned 80 Kc?

I make two suggestions for what they are worth:

(1) "Overshoot" or "ringing" effects added to high amplitude transients may carry an amplifier into a peak overload condition much more readily than might be expected from the average operating level. The result . . . a lack of clarity on transient peaks.



The diagram on the left indicates the ringing in the amplifier with high frequency square wave input, as originally received. On the right is the same signal condition but with reduced feedback and the optimum phasing capacitor.

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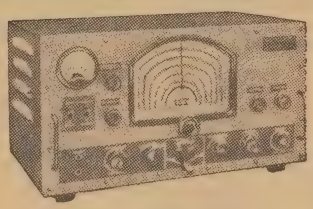

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| 1K5 | 2/6 |
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| 3S4 | 12/6 |
| 5V4 | 12/6 |
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| 6H6 | 3/11 |
| 6SN7 | 10/6 |
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2) Ringing components in an amplifier, triggered by complex input signals may beat with high order harmonics in the system to produce random components in the audible range; buzz, noise, &c.

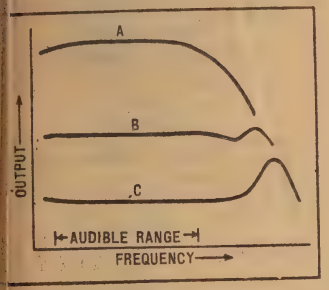
Could this be a reason for the impression of "muddiness" that allegedly separates a merely good amplifier from one that is nearer to perfection?

As I said earlier, "It's a 64-dollar question."

But what causes the "ringing" effect in amplifiers? This question is put to us at frequent intervals.

To answer it in detail would involve an excursion into vectors and phase angles, but we may be able to do it more simply than that. We'll try, anyway.

Curve "A" in the accompanying diagram may well represent the




Illustrating the effects of feedback on frequency response.

overall gain/response curve of a pentode amplifier without feedback. The position of the curve is meant to suggest that the overall gain is high and remains substantially flat over the audible range.

Outside the audible range, the gain tapers off, due to reactive losses in the circuit and more particularly in the output transformer.

If a moderate amount of negative feedback is applied from the output terminals of the amplifier to an early stage, the gain is reduced and the response made substantially level well up into the supersonic region. (Curve B).

## AN IMPROVEMENT

By and large, we accept this as a notable improvement and such it undoubtedly is.

**However, it is important to realise that the reactive components, which caused the drooping in curve "A" are still present in the amplifier, and, while their effect on gain is less noticeable, they do cause a shift in phase between the input and output voltages.**

Because this is so, it follows that feedback which is very carefully arranged to be 180 degrees negative in the audible spectrum, will become something other than true negative at extremes of the range.

The loss of negative feedback helps keep the gain/response curve flat, of course, but it also means that the limiting effect of feedback on output impedance and peak voltage generation is lost at these extreme frequencies.

Thus, an amplifier having 10 to 15db of feedback over the audible range may have little or no effective feedback at 50 Kc.

If one examines the response curve of a pentode feedback amplifier, it is not unusual to find a slight rise in gain at some extreme frequency, before the final roll-off occurs. But, provided it is only slight, it does not lead to any real bother.

In moderation, it can be countered easily enough by shunting the feedback network with enough capacitance to keep the phases in step at the high frequency end.

If, however, in mistaken zeal, we pile on more and more negative feedback in the audible range, we find ourselves automatically piling on more and more "other-than-negative" feedback at extreme frequencies.

If we push the process far enough, we can easily reach the condition where we have sufficient feedback, sufficient phase rotation and sufficient natural gain in the amplifier to evidence a quite definite regenerative effect at some remote and critical frequency.

The amplifier may not oscillate actively but a check on the response with a wide-range generator will reveal a curve something like "C" in the accompanying diagram. The height of the peak may easily reach 10db or more at some frequency typically between 50 and 100Kc, having all appearance of a resonance peak.

Where the peak occurs in the range, to what extent and with what degree of feedback depends primarily on the design of the output transformer.

## INPUT SIGNALS

Now let's see what happens when we use such an amplifier for ordinary domestic listening.

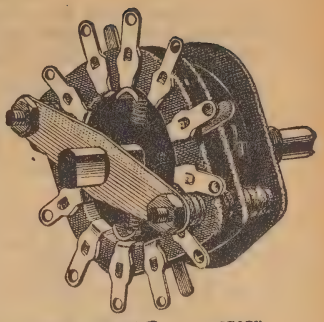
First of all, without feedback, only a small input signal is necessary to produce the required level of sound in the loudspeaker.

If a small amount of negative feedback is applied, the input signal has to be increased to produce the same audible output. So it goes on; the more feedback we apply, the greater the input signal has to be to sustain the output.

By the time we reach to condition envisaged by curve "C", the amplifier may be running with more than 10 times its original input signal, for only the same acoustic output.

But peaks, transients and complex waves at more than 10 times the

(Continued on Page 127)

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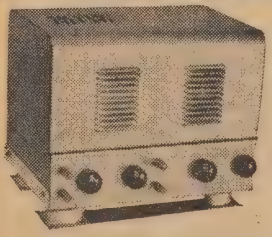

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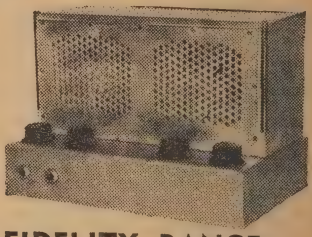

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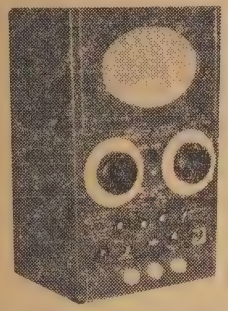

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# OFF THE RECORD — NEWS & REVIEWS

The recordings of Emory Cook have been circulating in America for some time, but have only recently been released here through Electronic Industries on the Nixa label. Until these appeared, Cook records were limited to a few specially imported discs of various kinds, including some binaural types which have interested enthusiasts in various parts of Australia.

## by John Moyle

COOK'S main interest is in recording. He is an extremely competent sound engineer, and has gone after his specialised market largely on the nature of the sound he has put on disc. He will go to no end of trouble to record anything, and some of his work has been outstanding in its field.

He is the man who made those organ records which impressed me so much, and to which I have referred more than once.

In discs, I have heard so far, it is evident he is striving to get all the sound into the grooves. I have never yet heard a Cook record in which this inner definition and clarity was not evident.

It is characteristic of all those in Nixa's first batch and it will fascinate or annoy you, according to what you are looking for in a record. For, in achieving his object, he creates an atmosphere of deadly, sharply-etched outlines which, for all their accuracy, are often not as acceptable musically as some less exacting standard.

On hi-fi equipment they are likely to raise your hair, but you will not always take them to your heart.

**MASTERPIECES FROM THE THEATRE—Carmen, Introduction to Act 1; The Thieving Magpie Overture; Midsummer Night's Dream Scherzo; Eurythanthe Overture. Played by the New Orchestral Society of Boston, conducted by Willis Page. Cook-Nixa SLPY801.**

I don't know this orchestra, but it sounds a fairly small group in a studio with controlled reverberation. It is probably recorded with multiple mikes, which have miraculously brought every group to a common level.

As a result, individual instruments are amazingly clear, and sound exactly as they would in such a studio It has a brilliance reminiscent of the 8H studio beloved by Toscanini, but with more life to it.

This clarity and definition are preserved with the full band, but in the effort to see that all sections are heard—and undoubtedly they are—we get the impression that we have multiple or elongated ears, able to take in full brass, a close-up of the cellos or basses, an unbelievably convincing tympani, and the rest, all at the same time.

The Scherzo bends under this treatment, but the remainder produce a brilliant row.

To accommodate the colossal dynamic range—greater I think than I have ever heard—wide groove spacing is used, and there isn't a trace of groove echo. The transient response and frequency range are equally impressive, with a low distortion content. Aiding and abetting all this is an orchestra which plays like a thing possessed.

This isn't a record to delight the musician, but it will make any sound engineer realise that Mr. Cook has plenty of clues about his job.

**KILTS ON PARADE—Played by the St. Columcille's United Gaelic Pipe Band—Sean McGonigal, Pipe Major. Cook-Nixa SLPY147.**

The bagpipes hold an honored place in the music-hall humor of the nation. Everyone makes jokes about them, but there is no greater magnet for uninhibited small boys and the young in heart than a good pipe band. My Irish ancestors are long dead, but they would lie unhappy if I were to deny my liking for their music.

This is a faithful representation of a good pipe band running through a repertoire which include, a round dozen standard pipe tunes played competently and straightforwardly.

They appear to have been made in the open air which is the only place to play the pipes. The microphone does not quite catch the magical fly-away atmosphere of the pipes, despite an endeavor to achieve it by having the band do a turn around the field.

I think the "Sounds of our Times" motto of Cook would have been served a little more by the inclusion of one or two solos—what's wrong with McCrimmon's Lament for instance? That would really have touched your heart.

Recording authenticity is highlighted by the drums—one could almost see them stride past, all ribbons, gaiters and flying sticks.

Incidentally I was glad to note that the nationality of the pipe major cannot be in doubt!

But alas—if those afore-mentioned jokes have any meaning, this one is strictly for the Irish and the Scots.

**CONCERTO IN C MINOR (Zabell), Etude in C (Vito), Fantasie Impromptu (Chopin), Valse Celebre (Moszowski), Gigue in Olden Style (Vito), Claire de Lune (Debussy), Malaguena (Lecuona). Played by Edward Vito, harpist. Cook-Nixa SLPY145.**

The solo repertoire of the harp is not large, and for this reason most harpists are forced to use arrangements which are more or less successful, depending greatly on the music, but just as greatly on the performer.

Therefore, some will not like to hear Claire de Lune and the Fantasie Impromptu as played by Vito, or by any other harpist for that matter. Personally, I thought the Debussy sounded just as good as in the original piano, but that's just my point of view.

Maybe I was influenced, too, by the recording, which is superb. Played at the right volume on high grade equipment it is breathtakingly alive.

Vito, too, is a very fine technician who plays the most difficult passages with complete precision and ease. Even in the Malaguena, which so obviously needs stronger forces to do it justice, he makes the harp and the room ring with sound.

Once again I give Cook high marks for a record which will be played many times for the sheer pleasure of high quality work. The surface is a good one.

**GOUNOD—Excerpts from Mirelle; BIZET—Excerpts from the Pearl Fishers. Sung by Janine Micheau (soprano), Pierre Cianotti (tenor), Libero de Luca (tenor), and Jean Borthayre (baritone), with the Paris Conservatoire and the National Opera Orchestras. Decca LXTA-2789.**

Neither of these operas is often performed today although there is good music in them both, particu-


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larly the Pearl Fishers. Excerpts, including some of those included here, are much more frequently heard, but rarely as well as on this new disc.

In fact it is the vividness of the recording which struck me most forcibly.

There is no trace of the streakiness which often appeared on Decca's earlier efforts. Much of the cutting is done at a high amplitude, but it is completely clear and free from any distortion. Occasionally there is a very faint groove echo.

There are some prominent but convincing sibilants when played back in the Decca position, but this can hardly be held as criticism.

It is more the natural result of close microphone placement, and if you were there, that's the way the singers would sound.

It is evidence, too, of the full frequency range used, to which the orchestra also bears witness. On both sides it is suitably subdued, but its liveliness of tone helps in the generally bright airiness of the disc.

I thoroughly enjoyed the music. Most excerpts strung together sound patchy and unsatisfying, but these are long enough and good enough to avoid this impression. For the most part the singing is exceedingly good, and both musically and technically this record must rank very highly.

The surface is near perfection.

**BRAHMS—Symphony No. 1 in C Minor Opus 68. Played by the Philharmonia Orchestra conducted by Guido Cantelli. HMV OALP1152.**

This is a first-class piece of Brahms—virtually a model performance in the traditional manner. With the Toscanini recording it shares first place among the versions available at the moment.

Toscanini's is a much higher pressure job. From the first bars to the exciting and dramatic ending it has an unmatched strength and power. Some don't altogether appreciate this conception, but with the exception of a few passages, I find it all the better for its extra tension and drive.

Cantelli plays with greater relaxation. He is not afraid to linger a little when shaping a phrase, nor does he lose the thread of his thought while doing so. His outlines are not etched as sharply, his attack while it has adequate weight is not as emphatic. Consequently his music flows where Toscanini's often marches, it is more beautiful than Toscanini's but less imposing.

If it is a matter of choice, the answer will lie in these directions rather than in any others, for the recordings technically are very much alike. Neither is a very forward recording, nor is there a great deal of reverberation, but what there is helps to hold the sound very well together.

Both surfaces are good, free from any noticeable clicks or swishes. Neither would win a hi-fi contest, but they are safe and satisfying. Most people include Brahms in their collections because they want to hear him often. Judged on this basis, Cantelli's effort is second to none.

**RUBINSTEIN — Concerto for Piano and Orchestra No. 4 in D Minor Opus 70. Played by Freidrich Wuhrer and the Vienna State Philharmonic Orchestra conducted by Rudolf Moralt. Vox PL7780.**

"The important thing about this D Minor Concerto is to realise what it stands for and to accept it at that, not seeking things which are not there. Rubinstein, after all, was no Beethoven, and this is no Emperor. It is, though, a thoroughly professional piece of writing from a composer who knew everything there was to know about the piano. It has a big, striking quality—some soaring themes—great momentum, and individuality."

This quotation from Charles Stanley's program notes on the jacket express my own feelings about the concerto so well that I need not apologise for using it.

Rubinstein's chief success was as a pianist, although he tried hard to become a great composer. Apart from some small pieces, this concerto is probably his best known work, and at one time was a tour de force of many famous keyboard exponents.

It is obviously the production of a man who played the piano stupendously, broadly and generously. It has no inner life at all, just pleasant, extroverted sound which often sounds grand and good.

The recording I thought excellent. The orchestral-piano balance remains poised throughout, and a smooth, quiet surface makes the best of a firm, clean recording, as good as anything Vox have released to date. The last movement particularly is a first-rate example of true concerto recording.

**CONTINENTAL CABARET—Popular French songs sung by Andre Claveau with Orchestra. Nixa LPY 125.**

Four catchy tunes sung in typical French cabaret style, intimately recorded against a completely silent background. Very clear, very forward, very pleasant.

There is a slight touch of roughness on the voice peaks here and there which may be due to the singer, but more likely to have grown in processing through somewhat high cutting amplitude. Probably only noticeable on wide range equipment using the recommended AES curve.

Of its kind, very good indeed. Note particularly the beautifully proportioned accompaniment. It's good to hear the balance like this.

**CHOPIN—Concerto No. 1 in E Minor Opus 11. Played by Frederich Gulda with the London Philharmonic Orchestra conducted by Sir Adrian Boult. Decca, LXTA2925.**

A Chopin piano concerto rarely achieves a stature in performance equal to this one.

Indeed, its appearance on an orchestral program is rarely a sub-


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ject for enthusiasm, with frequently an apology in the program notes for numerous faults and shortcomings on the part of the composer.

But there are no apologies made in this recording, either by Gulda or by Sir Adrian Boult. They set to to give it all they have, and that amounts to the most stimulating and exhilarating version I have ever heard, in the flesh or otherwise.

I give the pianist the fullest commendation. It is an education to see how he has absorbed his part, obviously with as much care and intelligence as is generally reserved for much weightier works. Not for him a mere run through the score, making the most of the pretty bits, banging out the loud bits, and scrambling through the rest.

He has worked on the thing until it has a shape and proportion which leave one with the fullest satisfaction.

His approach is admittedly firm—not for an instant will he allow himself to lapse into a languish or a meaningless fiddling. There are a few spots which are without doubt a bit threadbare, but these are handled with skill and dexterity.

Often their passage becomes a mere interlude between other sections, the interest of which has been deliberately heightened by a change in tempo or dynamics designed to draw the thread of attention away from them.

The performance is full of similar examples of highlights extracted and unsuspected colors brought to life.

In this the orchestra and conductor give him full understanding and support. Adrian Boult is not a glamor conductor but his musicianship is not always recognised as it should be.

Recording, surface, &c., are first rate. I have never enjoyed a Chopin record more than this one. I can't see it being tossed for many a day.

**MOZART—Serenade No. 10 in B flat major for Thirteen Wind Instruments, KV361. Played by the RIAS Chamber Group, Berlin. Radiola-Telefunken LE6504.**

There have been so many good records this month that it is hard to pick out the highlights. But this Radiola is definitely one of them.

Only Mozart could write such delightful music for a wind orchestra and it calls for a first-class group to turn in a performance of this standard.

No conductor's name is mentioned and I am wondering whether it was played without one, as was often the case in Mozart's time. I am doubtful, as the jacket note suggests, whether the music was ever written as a serenade to a fair lady. The term was rather loosely applied to music of this type, although it was frequently played out of doors and in someone's honor.

We can afford to forget such matters, however, and accept it as a suite in seven movements.

With or without conductor, the precision of the playing never falters and the ensemble is perfectly handled. Instrumental blending produces some beautiful effects and it would be hard to detect a flaw in any of the parts, despite the brisk pac which is maintained throughout.

Once or twice I thought it coul have been a little less so but in th slow movements on the second sid at least, I could find no fault. An after all, seven straight movement at one sitting is a fairly solid sessior

The extremely quiet surface is godsend, as any background distrac tions would have completely spoile the atmosphere of the music. Onl in the few grooves between eac movement could I hear any noise a all.

Although the score indicates double bass its place is taken by contra-bassoon, as is often done t avoid going outside the range of in struments. As with all the others its intonation is never at fault.

In short, one of Radiola's very best

**BRITTEN — Four Interludes from Peter Grimes—Passacaglia —Young Persons' Guide to the Orchestra. Played by the Concergebouw Orchestra of Amsterdam, conducted by Edward van Beinum. Decca LXTA-2886.**

The music from Peter Grime doesn't mean a great deal to anyone who hasn't seen the opera, and tha goes, I suppose, for all but a sprinkling of readers.

I can't do much more, therefore than to say that as descriptive music it is extremely brilliant and eloquently written, as it should be from one of the most important young English composers of the present day.

Being written around a program, an adequate exposition is really required, and as, unfortunately, my copy is without a cover, I can't say how far Decca has gone to help in this matter. But, then, Decca covers have always been good guides.

The Young Person's Guide to the Orchestra will need no notes of any kind. It is a skilful demonstration, not merely of individual instruments playing, but of how they may be used and combined in orchestral scoring.

It is truly a guide to the orchestra, and not merely to the instruments.

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The whole performance is worked into a set of variations on a theme by Purcell. Its charm pervades the whole score, despite the necessity to present it in every conceivable dress.

It is brilliant work, and its implied appeal only to young people is decidedly an understatement.

The performance and recording on both sides is really first-class. I donate the five stars, if only for the splendid balance, particularly in the "Guide", where, without any obvious highlighting of instruments, as is so often done in special demonstration records, each is faithfully presented.

In fact, the inclusion of concert-hall reverberation only makes the total sound more authentic. It is truly an orchestra on show. And what a splendid orchestra it is!

A record of particular value, and an essential purchase if you are an admirer of Britten.

**FAURE — Pelleas and Melisande; DUKAS—La Peri. Played by the l'Orchestra de l'Association des Concerts Colonne, conducted by George Sebastian. Nixa ULP9097.**

Beautifully smooth and sensitive playing, recorded in a chamber which allows this equally beautiful music to be suitably "aired", earn high points for Nixa with this disc.


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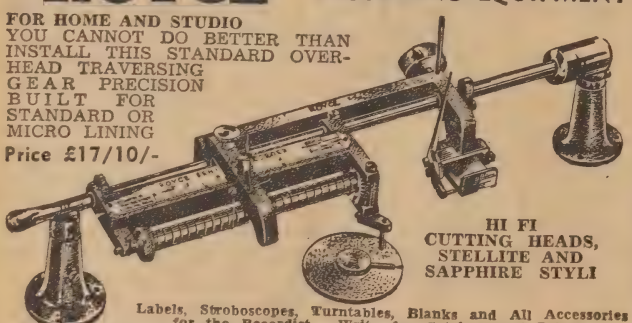

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The Pelleas and Melisande comes rom the incidental music of the pera, of which the Siciliene is freuently heard as a single item. All of has the same ethereal, nebulous haracter in keeping with Maeterncк's story. Great stress is laid on ne woodwind, of which the Colonne rchestra seems to have a very fine ollection.

Most people know Dukas through is Sorcerer's Apprentice, but La eri, a tone poem based on a Persian egend, the program of which is inluded on the record cover, is very ifferent stuff.

It is ballet music, being written in 911, the ballet being performed in ne following year. It was also Dukas' ast work of any size, although his utput was not large. It opens with fanfare which sounds good enough or a demonstration piece for brass —very, very nice recording.

It isn't particularly individual nusic. Soon after the opening, for nstance, we might easily have lipped into some unpublished secions from Scheherezade. Later on, ve might imagine much the same hing about the Pines of Rome. Nevertheless, it is well put together, oncrete evidence of Dukas' skill and nowledge of orchestration.

The recording is particularly clear. Bass and treble blend effectively and nobtrusively. It has good frequency nd dynamic range, and, luckily, surace noise is non-existent.

Once again, full marks for a wellroduced recording. The original is y Urania, and a special mention hould be made of a particularly asteful cover.

**BARTOK—Concerto No. 3 for piano and orchestra; PROKOFIEV—Concerto No. 3 in C major for piano and orchestra. Played by Julius Katchen with the Swiss Romande Orchestra conducted by Ernest Ansermet. Decca LXTA2894.**

This, I think, is a very valuable lisc in that it contains representative works for the piano from two of the nost important of modern composers — important for very different easons.

Bartok is being hailed by many as a successor to the very great in music. Whether he is or not, there is a clear contrast between these two works which even the partially music-sensitive person will immediately recognise.

It was Bartok's last work, being finished on his deathbed, and the last bars written in by Tibor Serly. Yet it is not nearly as abstruse as much of his other work and is simple by comparison. After a few hearings it will tell the listener a great deal about the Bartok idiom.

Prokofiev's concerto is much lighter in weight and will not be particularly difficult for anyone to follow and appreciate. It is quite a happy-hearted work, fitting a brilliant modern style into a form which is largely classical.

Both have a clear line of thought and lucid orchestration which I thought well suited Katchen. There is very little recorded comparison available, but it isn't needed to demonstrate that this is the kind of thing he does really well.

The orchestra and piano blend together in a recording which is not particularly forward and there are times when the piano might have been allowed to preserve its own outline more clearly.

But this is minor criticism. This is the only disc I know of in which both concertos are included and I would recommend it for this reason alone, even if technically it had not been so good.

The surface is silent and it plays well with the Decca setting.

**CESAR FRANCK—Symphony in D minor. Played by (a) Wilhelm Furtwangler and the Vienna Philharmonic Orchestra, Decca LXTA2905, and (b) Paul Paray and the Detroit Symphony Orchestra, Mercury MG50023.**

The Cesar Franck symphony presents quite a problem to the conductor.

Its musical material is almost pathetically typical of its composer, whose pre-occupation for almost endless development and improvisation takes him on a long journey along roads which, no matter how revolutionary they may have been in his time, are no novelty to us today.

The difficulty lies not in the material or its treatment but in its almost interminable length.

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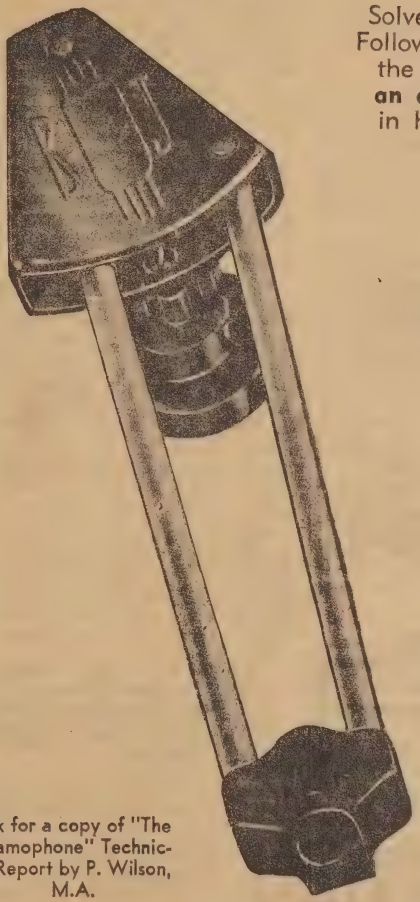

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less something is done to hold them interestingly together.

The job is made all the more difficult when we come up against cyclic form, which means that we can't look forward even to a completely new set of ideas as the symphony progresses.

There was a time when I could have listened to this music all day, luxuriating in its warm stream. The danger is that, wearying of this indolence, one will leave it for more vital pleasures, not willingly to return.

Furtwangler and Paray have tackled their task in completely different ways. This is evident from the first bar of the first movement.

Furtwangler, as he so often does, depends on his ability to shape and control the orchestra, moulding the music so that a slow and majestic tempo can be maintained. He assumes that Franck's judgment about sustaining interest under this treatment is sound and that the listener will not become wearied of what might seem an endless repetition.

Paul Paray takes it for granted that his audience will weary unless tempo and dynamics are used freely as an antidote.

## A MIDDLE COURSE

His version, while poetic enough where it should be, builds up climaxes to a pitch which Furtwangler does not reach.

To change quickly from one record to the other shows how completely different the two men are in their outlook on this symphony.

My own view is that the best line lies somewhere between them. Furtwangler's approach might be good in a concert hall. But with no external atmosphere it soon palls, underlining the weaknesses of the symphony, despite the extremely beautiful playing of the orchestra and the exquisite moulding of many passages.

Paray, on the other hand, overdoes his drive and vitality. Both are accentuated by a more forward recording, lacking in the extra reverberation which does a good deal to sustain Furtwangler's version.

Which disc you will like best depends on your own personal viewpoint. Musically, this is the essence of the difference between them.

Technically both are good. Furtwangler's is the smoother and his is the better orchestra. He gives more scope to the players to show their tone values. His surface is the quietest, although there isn't much to it. It takes the Decca curve well, while the Mercury sounds best wtih NAB.

**PAGANINI — Violin Concerto No. 4 in D Minor, played by Arthur Grimiaux and the Lamoureux Orchestra, conducted by Franco Gallini. Philips A00741R.**

This is the concerto which was recently discovered in manuscript form by a ragman in Parma, where it had graduated after remaining with Paganini's family for more than 100 years. Paganini only played it once, so that its performance in 1954, after the violin part had also been discovered, was quite a musical event.

This recording duplicates the second "first performance", using the same principals.

Paganini wrote a number of works for the violin and orchestra, and this concerto bears a striking resemblance in many ways to his first concerto. So much so that it set me hunting through my stock of 78's to emerge with a recording of it by Menuhin.

They are so much alike, particularly in the first movement, that one might almost think one was based on sketches for the other.

Musically, it is just as conventional as it could be. The melodies are pleasant enough and they progress with an inevitability that will make almost any listener imagine he has heard it all before.

## CONVENTIONAL

The subjects are contrasting, they are worked out with all the little repeats, modulations and decorations which abounded in works of that time. Paganini was primarily occupied in producing a pleasant-sounding and competently-written work which would allow the soloist to show off his playing and his instrument to best advantage. In this he has succeeded, and if the opus isn't world-shattering, it wasn't meant to be.

The star of the piece is undoubtedly Grimiaux, who shows up to even better advantage than in his recently released Mozart record. The recording, as well as the composer, has given him pride of place, and he gives a brilliant account of himself. Add a completely clean surface and you have as good a record of this concerto as you are ever likely to hear.

**SMETANA — The Moldau. DVORAK—Rhapsody No. 3 in A Flat Major. Played by the Residency Orchestra, The Hague, conducted by Antol Dorati. Philips N00620R.**

Both these items require just the kind of recording they have been given. A close mike technique could have broken up their smooth-flowing character, particularly in the Moldau, in which is given a word picture of the river flowing on in its passage, both stormy and placid, to the sea.

Even the flute, which tells of its birth high in the mountains, has just the right quality of diffusion which goes with adequate reverberation and a rather remote mike.

The Dvorak Rhapsody isn't the most instantly appealing, but all his rhapsodies and dances are lovely works, and everybody likes them.

Both sides exhibit a most une pected degree of bass in the extre register. If you have a well-baffl woofer you will hear tympani a bases of a pitch not normally ass ciated with straight releases, Phili or otherwise. It sounds most impre sive.

The surface is a good one, and t disc can be recommended for a library.

**BROADCAST RECITAL — by Kathleen Ferrier, accompanist Frederick Stone. Ten Songs by British Composers. Decca LXA3133.**

The record is taken from a BI broadcast on June 5, 1952, and o can only deplore the fact that t original was so poorly made.

Modern standards require virtu perfection with voices, and this far from perfection. In virtual every song there is distortion on sor notes and even with extra filtering is not entirely removed.

But for my part I would soon have this record than none at all.

I cannot share the view that Kat leen Ferrier had the most beautif contralto voice of her time, but I share the admiration for the way s used it.

Some of these songs are not ve distinguished, although they a popular. But her perfect taste a faultless vocal control make each memorable event. She approach them with the full sincerity that, f her at least, they are all worth whi There is no mannerism or affectatio only artistry to which such thin are foreign.

It is easy to see in these simp songs the qualities which struck immediately to the hearts of h listeners.

There are some discs in whi technical imperfections are ou weighed by the value of music records which cannot be repeate This is one of them.

**SCHUMANN — Dichterliebe, Opus 48. Dedication, The Nut Tree, Moonlight, The Lotus Bloom, Beautiful Stranger. Sung by Anton Dermota, tenor, with Hilda Dermota, accompanist. Radiola-Telefunken LE-6522.**

First impression of this disc is t completely silent surface—as good I have heard from Radiola—the fo wardness of the vocal recording, t tone of the piano accompanimer and the good balance between and the singer.

This favorable impression persis through the first few songs, some which are beautifully sung by a voi which is flexible and capable of beautiful singing tone.

But as the recording progresse things do not always go so happily These songs, telling, as they d the story of an unhappy love affa require a most subtle sense of co trast in mood from sheer joy, throug doubts, through fears, through de pair, to final unhappy resignatio No one song is like another, a they must be sung with this sense progressive proportion as a fir essential.

Dermota doesn't achieve this. H emotional range is limited, and h voice not capable of sufficie variety. He attempts to make up b an injected passion which gives th impression rather that he is workin too hard. His voice isn't big enou to achieve a really fine performanc

This impression isn't helped by close-mike technique, which high


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ghts his prominent lip noises, some-mes into unromantic splutterings.

## NOT ENOUGH VARIETY

Neither has he sufficient variety f tempo. His joy would be much ore convincing if his speed had een a little brighter, and yet he ngs No. 14, one of the loveliest of em all, so smartly that its signifi-ance is completely lost.

The piano accompaniment, with a w exceptions, is often extremely ood, but also extremely literal. The taccatto chords in No. 13 were surely ever meant to sound so much like oor knocks. And the final piano art which ends the work, one of the ost important moments of all, is urried through as though there were train to catch.

How different were the records ade by Gerhard Huish in prewar ays on 78 HMV's. It had its own aults, but never of this magnitude.

I would like to have been more enerous with this disc because there s so much good in it. Some of the est things lie in the extra five chumann songs which fill the second ide, all of which are in the front ank. But there it is—judge for your-elf. Maybe I know this work too ell for my own comfort.

**BEETHOVEN — Concerto for piano and orchestra No. 4 in G major Opus 58, played by Cor de Groot and the Vienna Symphony Orchestra conducted by Willem van Otterloo. Philips A00718R.**

There are two other fine recordings f this concerto which come to my ind and which I have available for eference—one by Badura-Skoda for Vestminster and another by Solomon or HMV.

This new Philips I must rank with hem for general quality, although all re so good in their own way.

Without detracting from Badura-koda, Solomon is the most interest-ng contrast. In the process we can bserve where both pianists are trongest and weakest.

## SINCERE PERFORMANCE

Cor de Groot without doubt is a ost versatile and successful pianist, ut he has not yet reached the matur-ty of Solomon. In any case, I doubt whether he will ever achieve Solo-non's sensitivity, although there are imes when this very virtue betrays im.

The slow movement of this con-erto illustrates perfectly what I nean.

Cor de Groot plays it strictly to he rules, sincerely, and without ffectation. In the conversational ection where piano and orchestra ndulge in a kind of statement and nswer he balances firmly and clear-y. But here Solomon has dropped nto a singing, glowing note of medi-ation in which the orchestra supplies nore a background of comment than conversation. Solomon has added o the musical idea a glowing con-eption of his own which I think is eyond the imagination of the ounger man.

It is this imaginative quality, heard hrough his whole performance, which makes the difference.

The Philips record is cut at a igher amplitude and with a closer nicrophone placement than the HMV. t isn't as smooth, either in its gen-ral effect or in the recording itself, which has a few slightly cracked piano notes on the second side.

But for all that it is a thoroughly good performance and one which could easily be preferred to the others if you like the finer touch.

The surface is satisfactory and the orchestra is fine.

**MOZART—Concerto in B flat K595 played by Robert Casadesus with the New York Philharmonic Orchestra conducted by Sir John Barbirolli. Columbia 33OC1028.**

I was rather disappointed in this record. This was Mozart's last piano concerto and has in it a forecast of the Beethoven who was to follow him. It calls for an appropriate performance, but far from developing its full stature Casadesus seems to be deliberately restricting it on lines which are almost miniature.

This approach might have been delightful for some earlier Mozart but reduces a fine work to just a pretty one.

Nor is the recording much help to him. It is not so remote as weak, its colors are pale and its impact almost nil.

There is also a faint but annoying tape noise and an unpardonable pitch waver near the end of the first movement.

Not really good enough.

**CONCERT GUITAR — Recital Gustavo Zepoli Cook-Nixa SLPX142.**

Ten varied pieces ranging from Bach to Albinez.

I cannot fault this as a piece of recording. Despite its high amplitude, there is no distortion of any kind, unless it can be some possible scale distortion in the listening, abetted by the extremely close mike placement.

By this I mean that if we were to place ourselves two feet from the bridge we would hear just what this disc gives us. But, as it is, the guitar doesn't sound as musical as that of Narcisco Yepes in his recent Decca recording of Spanish music, although Zepoli has little to learn as a technician.

Nowhere have I heard plucked strings which ring as realistically as these.

By far the best example is Leyanda, by Albeniz, true Spanish stuff, in which Zepoli is much more at home than in the Bach First Prelude, for instance. Here his range of dynamics and tone has plenty of appropriate scope, and produces some astonishingly vivid results.

The record sounds best played on AES with a little bass reinforcement, and has no trace of surface noise.

**BEETHOVEN — Symphony No. 1 in C major Opus 21, conducted by Carl Schuricht. Symphony No. 8 in F major opus 93 conducted by Karl Bohm. Played by the Vienna Philharmonic Orchestra. Decca LXTA-2824.**

These are two well recorded, sound performances, as good as you are likely to find on discs as they are at present.

They are very similar in their address to the music, and one could easily imagine them as being made at the same time.

The symphonies show Beethoven at both ends of the scale in his musical development, and those who may find some of his larger works too heavy going should have no cause to complain of this fine and tuneful music.

Both performances are in the


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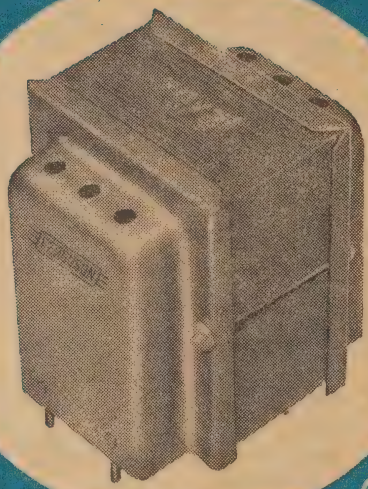

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AND in case there should be any doubts that today's LP's are not immeasurably better than the first attempts, it will be sufficient to go through the same process substituting early LP's for the 78's. What was outstanding four years ago is considered only fair average standard today.

How far LP's have come along the road to near perfection is demonstrated by the latest batch of records which have come in for review. I am not referring so much to the performances themselves as to the manner in which they have been recorded.

At last one is encouraged to hope that, before long, there will be no such thing as a bad record issued for sale.

Technicians can do so much more now with their discs than they could four years ago.

In the first place they have increased the playing time of each side to a stage where there is little point in trying to add to it.

## VARIABLE GROOVING

By the use of variable pitch, which closes up the grooves on quiet passages and opens them out on the louder passages, it is possible to get about 40 minutes' playing time on one side, and up to half-an-hour without unduly restricting the dynamic range of the record.

And if the depth of cut is varied at the same time, and with the same object in view, the grooves on quiet passages can be spaced even more closely together. Discs which previously occupied 12 inches can now be accommodated in 10 inches.

By the same technique, the 45 discs have had their playing time increased from about 5 1-3 minutes to about nine minutes.

Variable grooving has virtually eliminated that early scourge of LP's—inter-groove echo.

This was caused by heavily modulated grooves malforming the "land" which separated them from adjacent grooves, so that the latter carried a faint modulation from the heavy cutting. It is unusual now to hear more than a faint trace of this trouble.

The echo was most noticeable when a quiet groove followed or preceded a heavily cut groove, but it often caused serious intermodulation throughout heavy passages, an often unsuspected source of distortion.

Surfaces, too, have vastly improved.

The story of this improvement goes right back to the recording amplifier in which modern techniques and valves have greatly reduced valve noises. Recording tape is now greatly improved in sensitivity, and in other characteristics which allow a higher level of recording without distortion, and consequently less tape hiss. The recorders, too, are all quieter than they used to be.

In cutting the all-important disc from which the mother will be made, the biggest improvement of recent times has been the hot-stylus technique.

This provides for a small heater winding around the tip of the recording stylus. When fed with current, it heats the stylus, which now slices through the recording lacquer on the disc much more easily and smoothly.

## HOT STYLUS

A well-ground stylus will normally cut a very quiet groove in the lacquer, but with the "heat" on the stylus, even this amount of noise is immeasurably reduced. And as no polishing facets are now needed at the tip, as is customary with a cold stylus, a sharper and cleaner cut results.

In plating and in pressing, each factory has its own methods and secrets. High quality here is largely a matter of scrupulous care in the cleanliness of the baths, of the plating materials and in the finishing processes. Finally, with equal care in selecting the material from which the disc is made, and adequate control of the presses and their heat and pressure cycles, we finally emerge with the first class standard pressing of today.

As for recording techniques, it would take several full-sized articles to indicate just why the major companies are at last beginning to turn out records which are almost standardised in their high quality.

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As the full potential of modern records became evident, some stunning issues were made in which close recording and wide dynamic range were considered very largely pre-requisites for success.

## RECORDING BALANCE

And even now there are plenty of cases in which such recording is valuable and essential for the most vivid results.

But more important than these things is balance. This is very difficult to define, because there are no standards which can be written down. It is safe to say that the ultimate player arrangements for the best orchestral records, for instance, have been worked out by trial and error rather than by calculation.

It is at last realised that a big orchestra sounds best when there is enough of the concert hall atmosphere to allow reverberations to play their essential part in building up massed tone, and that reverberation must be controlled in rate of decay and dispersal if clarity is to be preserved.

**(Continued on Page 120)**


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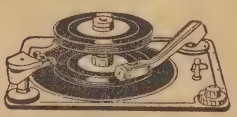

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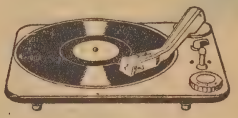

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# SHORT-WAVE NOTES BY ART CUSHEN

## Ceylon commercial service may close

**Information received from London states that the Commercial Service of Radio Ceylon may close down soon because of lack of financial support.**

THE Commercial Service of Radio Ceylon was established five years ago when experienced Australian broadcasters helped to plan the station. Its broadcasts are aimed at India and Pakistan and while the only opposition is from Radio Goa in Portuguese India, it appears that the failure of the service is caused by its poor coverage on medium wave. The Government - controlled stations of India and Pakistan do not carry advertisements.

On short-wave the Ceylon Commercial transmits with a 100-kilowatt Marconi transmitter which was originally installed by Radio SEAC (South-East Asia Command) which replaced the Forces station ZOJ during World War II. After the war the station was operated by the Ceylon Government before being taken over by the Commercial Service. It is expected that the transmitter will be used by the Voice of America which currently operates two 35kw Collins transmitters from near Colombo. These are beamed to South-East Asia and designated Colombo-I and Colombo LL.

The Commercial Service of Radio Ceylon nas its transmitter at Kandy, with studios in Torrington Square, Colombo. Its signals are heard regularly in Australia and New Zealand on 11770kcs from 11.30 am. Has also been logged opening at 9.30 pm on a frequency of 9520kcs.

## Higher power for Uganda

MR. GRAHAM PHILLIPS, the chief engineer of the new station being erected at Kampala, Uganda, advises that some delay is being experienced in transporting the new 7½kw Marconi transmitter from Mombasa to Kampala.

Consequently installation is well behind schedule but it is expected that test transmissions will begin on 5030kcs or 5060kcs about July.

Mr. Graham is not very optimistic about the chances of being received in Australasia since the transmitting array is of a vertical incidence type whereby energy is fed vertically for reflection from the ionosphere for the critical frequency. While, in theory, this will give excellent coverage for Uganda, low-angle radiation required for long-distance transmission will be extremely small.

However, theoretical considerations are often wrong and it will be interesting to see who is first to log Radio Kampala . . . they will be very interested to hear from anybody who hears the station.

## DX FLASHES

**INDONESIA.**— YDF6 (9710) and YDF7 (11770) now carries a program to Europe from 3.30 am to 6.0 am.

**LIBERIA.**— Station ELWA, Box 192 Monrovia, is operating on 15200kcs, instead of 11800kcs, from 2.30 am to 4.30 am. QSL cards have been printed and ELWA is interested in hearing from DXers around the world.

**NORTH AFRICA.**— Forces Broadcasting Service Benghazi, Tripoli and Fayid are all expected to transfer from North Africa within a year. Cyprus and Malta are suggested as the new sites, the present temporary headquarters of FBS being in Cyprus.

**EGYPT.**— Cairo has been heard in Spanish from 11.0 am to 11.30 am on 11670kcs with transmissions directed to South America.

**VATICAN.**— The Vatican Radio has English transmissions from 4.15 am daily over 6190kcs, 7280, 9646 and 11685kcs. Also at 2.0 am on Tuesdays over 9646kcs and 11685kcs to India, Pakistan and Ceylon.

**MEXICO.**— XEXX, "La Voz de la America Latina" Mexico City, is using 15165kcs in parallel with 9500kcs and signs off at 4.0 p.m.

**ARGENTINA.**— LRS, "Radio Splendid," Buenos Aires, operates on a frequency of 11880kcs from 7.0 am to 2.0 pm.

## WINTER SW SCHEDULES

WITH the advent of winter there a numerous alterations in the schedu in the various broadcasting organisatio Below we list some or those hea regularly both in the Commonwealth a New Zealand.

**Radio New Zealand.**— To Austral ZL19 (11830) 6.0 am to 4.0 pm, ZL (9520)) 4.15 pm to close down. To Paci Islands, ZL20 (6020) 3.0 am to 6.30 a ZL3 (11780) 6.45 am to 4.0 pm, Z (6080) 4.15 pm to close down. Close do times are 8.45 pm week days, 9.20 p Saturdays, 8.0 pm Sundays. News bullet are. London news at 4.0 am, 5.0 am, 6.0 a 4.30 pm and NZ news at 10.33 am, 6 pm and 8.30 pm. ZL20 is a new stati

**Switzerland.**— HER5 (11865), HE (15305), HEU7 (17720) from 5.15 pm 7.45 pm. HEU6 (15315) 2.15 am to 8.30 a HEU7 and HEU6 are new stations.

**BBC.**— General Overseas Service dire ed to Australasia, GWZ (7200) M (9760) 4.0 pm to 6.0 pm, GVZ (11930), G (15070) GSI (15260) 7.30 pm to 9.15 p GRI (9410) 6.0 am to 7.0 am, (9600) G (12040) GSI (15260) 6.0 am to 8.15 a GSN (11820) 7.0 am to 8.15 am Pac Service, (7220) (9625) 4.0 pm to 5.0 p (7220) GVZ (9640) GVY (11955) 4.0 to 5.0 pm. The British Far East Broadcasting Service, Singapore, rel GOS news bulletins on 7210kcs, 9690 15435kcs, from 9.0 pm to 9.15 pm and 9690kcs, 11820kcs, 11955kcs, 15300kcs f 11.0 pm to 11.15 pm.

**Radio Canada.**— Australian Serv CKCX (15190) CKLO (9630) 10.55 am 11.15 am CKLO (9630) CKNA (5970) pm to 7.20 pm. The above transmissi are a relay for Canadian troops in Ko via Australian. An Australasian serv over CKCX and CKLO is also broad from 11.15 am to 11.50 am daily.

## Short-wave schedule for Radio Japan

| DIRECTION | TIME | FREQUENCY |
|---|---|---|
| Western North America | 3.0 to 4.0 pm | JOA-5 15225 kc<br>JOB-6 11725 " |
| Hawaii | 5.0 to 6.0 pm | JOA-5 15225 kc<br>JOB-6 11725 " |
| South America | 9.0 to 10.0 pm | JOA-4 11705 kc<br>JOB-5 15235 " |
| Australia & New Zealand | 7.0 to 8.0 pm | JOA-5 15225 kc<br>JOB-6 11725 " |
| North & Central China | 8.30 to 10.30 pm | JOA-4 11705 kc<br>JOB-3 9675 " |
| South China | mid. to 1.0 pm | JOA-4 11705 kc<br>JOB-5 15235 " |
| Philippines & Indonesia | 10.45 to 11.45 pm | JOA-4 11705 kc<br>JOB-5 15235 " |
| Indo-China, Thailand & Burma | 1.0 to 2.0 pm | JOA-4 11705 kc<br>JOB-5 15235 " |
| India & Pakistan | 2.15 to 3.15 am | JOA-4 11705 kc<br>JOB-5 15235 " |
| Near East | 3.30 to 4.30 am | JOA-4 11705 kc<br>JOB-3 9675 " |
| Europe | 5.0 to 6.0 am | JOA-4 11705 kc<br>JOB-3 9675 " |


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# THE HAM BANDS WITH BILL MOORE

**Judging from experience gained to date in the UK, America and on the Continent, TVI committees set up by interested parties can carry out valuable work in providing correct information to the general public on the sources of interference.**

OCTOR ROBERT BLACK, VK2QZ, presented to the NSW Division an tensive report on a scheme for com-ting BCI and TVI. Bob is the chair-n of the BCI and TVI Committee of VHF section.

He suggests the appointment of a BCI d TVI officer for the division to pervise all work in these spheres. Be-es the committee running currently the VHF group, an HF: BCI and TVI mmittee should be formed to deal with ch interference below 50 Mcs.

Two separate committees would then in operation covering the varied prob-ms arising in both sections of the ectrum.

The divisional officer would be re-onsible for the co-ordination of ideas, ties, &c.

Great emphasis has been placed on e work of interference committees verseas. They have been responsible many cases for presenting TVI from mateurs in the right perspective to the eneral public.

One great problem has been the fact at TV servicemen have been blaming mateurs for all interference.

Philip S. Rand, W1DMB, one of merica's leading TVI experts and QST echnical consultant in his lectures roughout the continent, emphasised this oint, and in his displays showed how many pieces of electrical equipment con-ributed to the overall problem. Trans-itters are only one source of disturb-nce to viewers.

In the US the FCC sponsors local TVI committees, which generally comprise amateurs, servicemen, distributors, &c., and the commission directed their regional managers to assist the setting-up of committees.

While each committee usually outlines its own objectives, those covering amateur operation were generally as follows:—(1) To provide assistance for those amateurs who are restricting their amateur radio activities because of TVI. (2) To investigate amateur TVI complaints where the amateur is known or accused. (3) Crusade for a better understanding between all parties concerned with TVI Integrate this with an educational program for both the general public and TV service personnel. (4) Provide a clearing house for the co-ordination of the co-operative efforts of all concerned directly or indirectly with TVI.

A number of improvements have been noted since the advent of these committees and a decline in the petitions against amateur operations have been marked. One factor has been the arrangement worked out between the FCC and TV receiver manufacturers in which high pass filters have been installed when the interference was due to receiver deficiences.

High pass filters have been the subject of much discussion by Philip Rand, who wrote to some 40 manufacturers, suggesting that they be incorporated in all receivers. Similar action may be encouraged here in Australia.

## THE 3.5 Mc BAND

THE 3.5 Mc band has over a number of years played an important part in allowing amateurs trying to improve their 144 Mc. coverage to line up schedules on the VHF band. Immediate checks on signal reports on the signals were available.

In view of the fact that so many country VHF stations are using the 3.5 Mc. band, the NSW division's VHF section liaison officer, Pere Healy, VK2APQ, will operate on this band each Wednesday evening to keep amateurs in touch with VHF events.

Country amateurs in both NSW and Victoria are still extending their range on 144 Mcs. One interesting nightly schedule, so commonplace these days that it is often forgotten, is the 2000 hrs. daily contact on 144 Mcs. between Hugh Stitt, VK2WH, of Forbes, and John Miller, VK2ANF, of Sydney. Over the 180-mile path across the Blue Mountains, rising some 2500ft., the schedule has run since 1953 and although signals are weak at times they have always been audible and contact established.

In Victoria and NSW the active stations using 3.5 Mcs. for checking are VK2WH, VK2AJO, VK2RS, VK3UI, VK3CI, VK3JK, VK3BQ, VK3ATN and others. VK2WH and VK3ATN have linked on 144 Mcs. over a 340-mile path. VK3ATN has also contacted VK5MT in Adelaide.

## 144 Mc OPENINGS

LATEST information is to the effect that the 144 Mcs operators in these districts were rewarded for their work and time spent on schedules by two good openings.

On May 31 and June 1 during the evenings the band was wide open between Melbourne and other parts of Victoria through to Forbes in mid-NSW. Schedules has been running each evening from Max Howden, VK3BQ, Melbourne, and Hugh Stitt, VK2WH, Forbes, for some weeks. The latter station contacted VK3CI, VK3BQ, VK3YS, VK3BG, VK3BW, VK3CP, VK3RK, XK2ZAA and VK2AJO.

## CIVIL DEFENCE

FOLLOWING the official announcement of the forming of a Civil Defence organisation in NSW, State president Jim Corbin VK2YC, and secretary Harry Hicken, VK2ACH, representing the NSW WIA divisional council, met Mr. Hicks, State emergency co-ordinator, and a discussion was held on the work of amateur radio operators in emergency. A map showing the location of amateurs throughout the State was inspected.

It clearly showed the wide cover that could be afforded by any amateur net.

The discussion was on general lines only but it was apparent that amateurs can play an important prt in the communications section of any CD scheme.

Mr. Hicks was well aware of the past work of radio amateurs, especially in the National Emergency Services during the last war.

The NES net during this period was under the control of the late Wal Ryan, VK2TI. The whole of the CD organisation will be co-ordinated by Federal authorities and the final general plan will emanate from that sphere.

## AMATEUR PUBLICATIONS

A QST editorial reports the remarkable circulation of the various ARRL publications, reaching "best-sellers" classification.

Since its introduction in 1926, the ARRL's Amateur Radio Handbook has sold nearly 3-million copies, the Licence manual passed the 1-million mark, How To Become A Radio Amateur, 500,000 copies, The Antenna Handbook, 250,000 copies, and other publications have reached comparative levels.

The RSGB has been so far unsuccessful in obtaining permission from the GPO to operate a news bulletin service on amateur radio affairs. It was hoped to initiate a service as afforded Australian amateurs by the WIA through WI divisional stations. The GPO has written to Empire and foreign administrations who permit such services to obtain their views. An early reply to the societies' request is anticipated.

## WIA ORGANISATION

THE Wireless Institute of Australia, one of the oldest radio societies, is officially recognised throughout the world as representing the Australian Radio Amateur.

Divisions of the institute operate in all States and the Territory of Papua and New Guinea and welcome members from radio amateurs and enthusiasts.

Federally, the institute is represented by the Federal executive, at present located in Melbourne; they carry out the necessary liaison with the PMG's Department and international organisations.

All VK amateurs should become members of the institute. It is only with the assistance of all radio amateurs can it function effectively.

The membership is essentially divided into two grades, Full and Associate.

Full membership is limited to holders of an AOCP; associate membership is available to prospective amateurs and radio enthusiasts. Special short-wave listeners' sections are conducted in some divisions.

Inquiries with reference to membership should be directed to the divisional secretaries in the State you are resident. Appropriate addresses are listed below.

NSW Division: Secretary, Harry Hicken, VK2ACH, Box 1734, GPO, Sydney.

Victorian Division: Secretary, C. Gibson, VK3FO, COR House, 191 Queen St., Melbourne.

Queensland Division: Secretary, W. A. Young, VK4YA, Box 638J, GPO, Brisbane.

South Australian Division: Secretary, R. G. Harris, VK5RR, Box 1234K, GPO, Adelaide.

Western Australian Division: Secretary, J. Mead, VK6LJ, Box N1002, GPO Perth.

Tasmanian Division: Secretary, W. G. Tait, Box 371B, GPO, Hobart.

Papua-New Guinea Division: Secretary, D. F. Lloyd, VK9OQ, c/o OTC Receiving Station, Port Moresby.

## INTERFERENCE

COMMERCIAL interference on the shared 3.5 Mc band is becoming troublesome in Great Britain. The RSGB has pointed out to the GPO that some UK stations using the shared band are running inputs up to 20 KW, making rather a deep impression on the band.

In some areas it is impossible for amateurs to utilise this frequency range. They suggest some form of time sharing. The society also complained of "intruders" in the exclusive sections of the 7 and 14 Mc. bands.

A conference at high level is suggested to consider the societies' views. The RSGB special regulations committee is in close liaison with the GPO on all regulatory matters.

## MORE CERTIFICATES

ANOTHER Dx certificate to adorn the shack wall is the Alaskan award currently available. It is designed to provide widespread interest in working KL7 stations.

The Anchorage Amateur Radio Club is issuing the Alaskan Dx award. Applicants are requested to submit QSL cards from 10 different KL7 stations. Four of these cards must be from amateurs who are members of the club. Contacts may be on any band or combination of bands and either on CW or telephony.

Applicants for the award should be forwarded to the Anchorage Amateur Radio Club, Post Office 211, Anchorage, Alaska; further details as to club members, &c., can be obtained from the club.

The latest regulatory change in the US is the opening of the 50 Mcs. band

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echnical Class Licencees. The ARRL
been pressing for this change to
w greater occupancy of the band.
the past this class of licencee was
mitted to operate on the 144 Mc. band
higher.
has. Mellon, WIFH's tally in the ARRL
n DCCC, has taken a sharp rise to
countries, confirmed by QSL post-
His nearest rival is W6VFR, with
countries.
he telephony section totals have risen
, with PY2CK running 238 countries.
Oceania New Zealanders lead both
tions. ZL2GX with 235 confirmed in
open section, and ZL1HY, 190 con
ned in the telephony section.

## VHF CONTEST

HE annual mid-winter contest of the
VHF section of the NSW division will
held on the 144 Mc. band on atur-
, July 16, and Sunday, July 17.
ontest periods will extend from 7 pm
11 pm on both evenings. The winner
ll be the station making the greatest
mber of contacts in the total period
Five-figure serial numbers will be ex-
anged, the first two digits covering
e signal report and the last three any
mber from 000 to 999, progressing by
e as each contact is made.
It is hoped that all stations competing
ll forward logs; they should reach
e contest manager, John Miller
K2ANF, not later than July 31.
Excellent tropospheric bending on 144
c. was experienced during the month
id a number of contacts made to the
orth from Sydney. On one evening
K2ANF contacted VK2BZ, Newcastle.
K2VU, Singleton, and VK2ANU, near
uswellbrook, the latter contact over
0 miles. VK2HE, Sydney, has also
een contacting VK2BZ, Newcastle,
ound midday. VK2RU, of Gosford, is
lso heard at good strength.
The nocturnal fox hunt of the NSW
HF section, held late in May, was won
y Horry Lapthorne, VK2HL, and
harlie Fryar, VK2NP, in the excellent
ime of 40 minutes. They travelled some
2 miles in the process. The fox, John
iller, VK2ANF, selected a difficult loca-
ion and those on the search had to
ravel away from the hidden transmitter
nd move in a circle to return to the
nly entrance road. Some 25 amateurs
athered at the conclusion of the search
o participate in supper.

## V INTERFERENCE

The position of radio amateurs in the VHF spectrum with the advent of television was clarified by a statement prepared by the Federal executive of the WIA, forwarded to the various divisions and broadcast over WIA official stations.

The Federal executive has been active checking the latest proposed frequency allocations for TV with Broadcast Control Board engineers.

It would appear that the 50-54 Mcs. band moves to the 56-60 Mcs. (the old allocation and in harmonic relationship with HF bands) in the near future.

Some years will elapse before the 144-148 Mcs. band is changed and it will be moved to 146 to 150 Mcs. Final allocations will undoubtedly be announced in the near future.

Some comment has been centred on the harmonic relationship of amateur bands in the TV frequencies. It would be practically impossible to make any allocations at VHF's without some clashing with possible harmonics.

Amateur transmitters will have to be cleared from such emissions, anyway.

Some time ago, as mentioned in these columns, the 144 Mc. band subdivision arranged in Great Britain, allowing stations in different areas to use special segments of the band, was in full operation. A similar scheme has now been introduced in France by the National Amateur Society, the REF.

The band is dividend into 11 segments, varying in width from 150 to 200 Kcs. depending on the amateur population in the area of the allocation.

Of interest is a section from 145.7 to 146.0 Mcs. set aside for local working in any area, releasing the other portions of the band for contacts over greater distances. The band incidentally only extends from 144 to 146 Mcs. in France, as in other parts of Europe. The plan has been well received in France and should assist to relieve interference on the band.

In the US, amateurs are viewing the problems common to the band in a different manner and are looking for some general agreement that will permit uninterrupted CW Dx working.

There is strong support for an exclusive CW segment located at the low edge of the band, in many cases it has been found that when stations are "stretching out", CW affords the only method of making contact with the weak and fading signals.

QRM has become increasingly severe on the band edge and it only takes a few strong phone stations to obliterate the section from 144 to 144.2 Mcs. Some amateurs have already petitioned the FCC on the matter of a CW allocation on the low edge.

As an alternative, it is suggested that the section 144.0 to 144.2 Mcs. be set aside by mutual agreement for CW, Dx working and special schedules, and that all local and, for that matter, distant "rag-chewing", be positioned up the band.

## AOCP CLASSES

THE WIA NSW Division's AOCP classes are running very smoothly and the current class is attended by 27 members. It is anticipated in view of the interest of country enthusiasts to commence shortly a correspondence class for intending amateurs.

Ken Kimberley, VK2AXZ, is in charge of this project. Any inquiries on AOCP class matters should be directed to the Class Manager, WIA NSW Division, Box 1734, GPO, Sydney.

## HAM COMES HOME

AMATEURS were gratified to learn of the release from captivity of Robert Ford, AC4RF, who has been a prisoner of the Chinese communists since they over-ran Tibet in 1950. It was announced that he had been deported from China over the ABCC news on May 29.

Together with the late Reg Fox, AC4YN, who died while a prisoner, they were among the rarest Dx stations in the world.

Few details of Bob's release were available other than he had been released after serving less than the scheduled sentence for operating an "illegal" transmitter.

It is hoped Bob will again appear on the ham bands and renew acquaintances with his many amateur friends.

## WIDER COVERAGE

RON FISHER, VK3OM, offers some fair criticism on this column, mainly to the effect that it only covers amateur activity in NSW, creating the impression that it is the only State in the Commonwealth!

News from other States is generally difficult to obtain despite several serious endeavors on the subject.

Any notes on amateur activity from other States would be appreciated. Space is available and events needing publicity will be duly covered.

Any material could be forwarded to the Editor, Radio, TV and Hobbies, 60-70 Elizabeth St., Sydney, or direct to W. Moore, VK2HZ, Pitt St., Springwood, to arrive not later than the third of the month for inclusion in the following issue.



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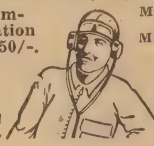

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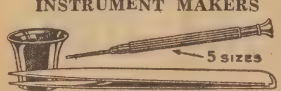


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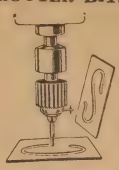

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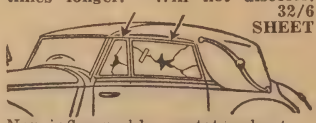

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English 0-5 Milliammeters, 2½in . . 27/

English 0-25 Ammeters, 2½in M/c 30/

English 0-10 Ammeters, 2½in dial, Moving Coil . . . . . 45/

English 0-30 Voltmeters, 2½in dial, AC-DC . . . . . 42/

English 0-40 Ammeters, 2½in dial, AC-DC . . . . . 42/

English 0-30 Ammeters, 2½in dial, AC-DC . . . . . 45/

English 0-150 Voltmeter, 3in dial, Moving Coil . . . . . 39/

Eng. 0-500 Micro Ammeter, M/Coil 37/

Eng. 0-20 amps, 2in dial, M/c. . 25/

Eng. 0-1½ Milliamps, 2in dial, M/c. 19/

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Eng. 20-0-20 Ammeter, M/Coil . . 37/

Eng. 0-30 Amps AC-DC 2½in dial . . 42/

Eng. 0-50 Amps AC-DC 3½in dial 75/

Eng. 0-60 Amps AC-DC 3½in dial 75/

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Eng. 0-1 Amps DC 2½in dial . . 35/

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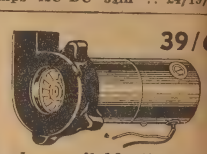

**39/6**

Large size also available that will work off 12 or 24 volts, **£3/15/-.**

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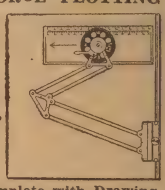
**AIR FORCE PLOTTING BOARD**

Ideal for use as Students' drawing board



**25/-** Complete

Complete with Drawing Arm

---

**BRAND NEW LEVER TYPE GREASE GUNS WORTH £4/19/6**

**59/6**

Ideal for all types of Trucks, Tractors or Cars. 7500lb pressure.

---

**ARMY FOCUSING TELESCOPE**

Easily converted for use on dumpy levels. Can be used as a rifle sight. Excellent magnification . . **£4/19/6**

Fitted with cross hair.

ADJUSTABLE FOCUS

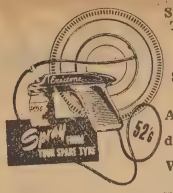
# STORES

512 Elizabeth St., Melbourne, C.1.
om Victoria Street. Phone FJ5904.
and Efficiently Despatched
Include State in Address

IN FIRST-CLASS ORDER DALTON COMPUTERS IDEAL FOR AERO CLUB, 45/-.

66in wide waterproof canvas 15/- yd. Fish-pond aerators, work off 230 volts, 57/6. Officer type Blackboots, 42/-.

Spray YOUR CAR, TOYS, HOBBIES, FURNITURE
52/6
Spray from your Spare Tyre.




An ideal Tool for touching up damaged paintwork
Will spray Lacquer Paint, Enamel.

BALL AND SOCKET INSPECTION MIRROR

8/9

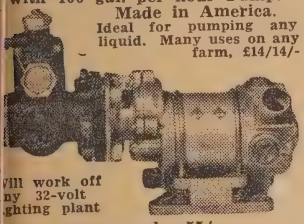
Ideal for mechanics, radio repairs

last the spotlight you have been waiting for

tted with genuine merican sealed am globes. No otorist or boat vner should be without one. 6 Volt, 70/-; 12 Volt, 76/-. Fitted with Switch and Flex.

Ideal for Fox or Rabbit Shooting

ircraft 24 volt Motor complete with 400 gal. per hour Pump. Made in America. Ideal for pumping any liquid. Many uses on any farm, £14/14/-

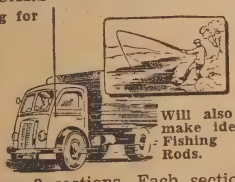


Will work off ny 32-volt ghting plant

Pump only, 55/-.

STEEL ARMY TANK AERIAL RODS WILL MAKE IDEAL RADIO AERIALS FOR CARS OR TRUCKS

Too long for postage. Advise nearest railway station.



Bases to suit Aerials, 12/6 each.

Will also make ideal Fishing Rods.

12ft long, 3 sections. Each section 4ft, 22/6. 8ft long, 2 sections, 15/-

Brand new American Wobble Pump, semi-rotary.

PHOSPHOR BRONZE VANES

Continuous flow. £3/19/6.

Ideal for caravans, emptying or filling petrol tanks, watertanks, etc.

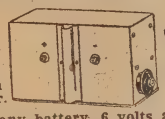
ENGLISH ARMY SPOTLIGHTS

IDEAL FOR SHOOTING. FIT ONE TO YOUR CAR.
6-volt 37/6.
12-volt 25/-.

Fitted with Mirror Reflector.

COMPLETE BATTERY CHARGER

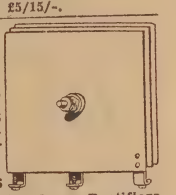
Fitted with Brand New English Selenium Rectifier.



Works off 230v. Household Supply.

Charges any battery, 6 volts at 4 amps, £6/15/- complete. Also available, 6 or 12 volt Charger combined. Charge 3 amps. £7/15/-. Brand new 6 volt, 3 amp. Chargers, complete, £5/15/-.

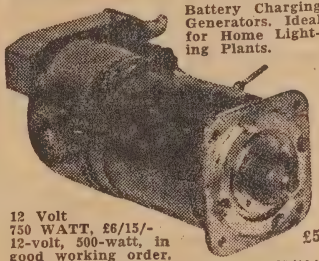
Not secondhand. BRAND NEW ENGLISH G.E.C. RECTIFIERS



Make yourself a Battery Charger.

| | |
|---|---|
| 12v. 2 amp. | 32/6 |
| 6v. 5 amp. | 50/- |
| 12 v. 3 amp. | 45/- |
| 6 v. 2 amp. | 24/6 |
| 6 v. 4 amp. | 45/- |
| 12v. 5 amp. | 79/6 |

Transformers to suit above Rectifiers. 2 amps, 37/6; 6 volt, 5 amp, 45/-; 12 volt, 5 amp, 55/-.

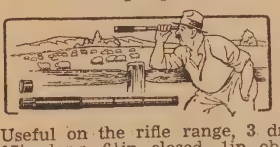


Battery Charging Generators. Ideal for Home Lighting Plants.

12 Volt
750 WATT, £6/15/-
12-volt, 500-watt, in good working order. £5
24-volt, 1000-watt .. .. .. .. .. £8/10/-

200 amp Generator. Ideal for welding. Made in America. Brand new .. .. .. .. .. .. £40

ARMY SPOTTING TELESCOPES
Many uses on the farm. Ideal for Sheep Spotting.



Useful on the rifle range, 3 draw 17in long, 6½in closed, 1in object lens, 18 magnification. Made in England .. .. £7/19/6

RAAF VARIABLE RHEOSTATS


2 OHMS 100 WATTS IDEAL FOR BATTERY CHARGERS.

15/- EACH

Ideal for control of motors, Electric Trains, Lights, etc.

SPECIAL OFFERS FROM OUR NEW MOTOR ACCESSORY DEPARTMENT

American Schrader tyre pumps, work from your spark plugs, 39/6. Car type fire extinguisher. Every car should carry one. Cost £7/10/-£4/10/-. Steel mechanic's tool boxes, 19/6. Brand new 7/8in spark plugs, suit most old type cars, 2/6, or ideal for tractors S.A.E. or Whit. Spanner Sets, open one end, ring the other. 6 spanners to set, 23/6. Army steel tow ropes, looped ends, 17/6. S.A.E. open end spanners, 6 to set, 24/6 Whitworth, 4 to set, 18/6. Whit socket sets, 13/6 set. Mudguard type rear view mirrors, 16/6. Inside car rear view mirrors, 4/11 S.A.E. socket sets, 15/-. Stick on type ash trays, 4/-. Engineer's pliers, 4/6. Car jacks, 37/6. Tyre levers, 3/10 each. Hydraulic 2-ton jacks, £4/15/-. 6 volt windscreen wipers, £4/12/6. 12 volt, £4/19/6. Car pumps, 14/-. Shifting Spanners 4in, 6/9; 6in 8/-; 8in 10/-; 10in, 11/-; 12in, 18/6. Metric Socket Set, complete with bar, 59/6. Feeler Gauges, 4/6. Tail Lights, 5/9. 12in Steel Rulers, 3/6. 6in, 2/6. Set of 3 Screwdrivers, 2/6. Hydrometers, 11/6. Piston Ring Compressors, 15/-. Pressure Oil Cans. 19/6. Combination Pliers. 5/6. Multi Grips, 10/6. Car Amp Meters, 15/6. 4½in saw blades complete with arbor, ideal for making saw bench with electric drill, 25/-. Bell-ringing generators, ideal for telephones, 25/-. German Army marching compasses, work similar to prismatic, 29/6. 110 volt 1000 watt projector globes, 32/6. ¼in Black and Decker 230 volt electric drills, £11/15/-. ½in, £24/8/3. Magnifying Glasses, 8 mags., 8/6. 10 magnifications, 12/6. 24 volt motor and hydraulic pump, capacity 3½ gals. per minute, £3/15/-. New headphones suitable for crystal sets, 17/6 pair. Army Mosquito Nets, ideal camping, 27/6. Genuine RAAF Berets, 10/6. Tapped Transformers, 6, 12, 18 and 24 volts, 3 amps, 39/6. 230 volts input. Brand new American Cutting and Welding Torches £4/4/-complete. Army Slouch Hats in good order, 15/-. Generator Test Meters, 35-0-35 amp meters, 4½in dial, 45/-. 0-10 volt meters, 4½in dial, 45/-. Loading Reristors can be supplied to make meter read 10.20 at 12/6. Medical Scalpels many uses, photographers. etc 6/6. Motorist Clip-on Trouble Lights with magnified bull's-eye lens, 6 volt, 7/6; 12 volt, 6/6.

# MOTOR SPARES LTD

## SPECIALS

1. Convert your old record player to play new microgroove recordings. Simply place the adaptor plate on top of your old 78RPM turntable and it will convert the speed to 33RPM. A special pick-up is provided for the microgroove recordings. Normal price £11/17/6.
   Our price **£5.**
2. **BARGAINS IN BLOCK CONDENSERS.** New condensers in good order.
   4mfd 750 volt wkg. .. **5/9 ea.**
   5mfd 400 volt wkg. .. **5/- ea.**
   4mfd 200 volt wkg. .. **2/9 ea.**
   4mfd 600 volt wkg. .. **5/9 ea.**
   2mfd 3000 volt wkg. . **7/6 ea.**
   2mfd 400 volt wkg. .. **3/9 ea.**
   2½ + 2½ + 1mfd .. .. **3/6 ea.**
   1mfd 400 volt wkg. .. **2/9 ea.**
   1mfd 200 volt wkg. .. **2/- ea.**
   1mfd 100 volt wkg. .. **1/3 ea.**
   .5mfd 400 volt wkg. .... **1/6 ea.**
   .5mfd 3000 volt wkg. .. **3/9 ea.**
   .25mfd 3000 volt wkg. . **3/3 ea.**
   3x .1mfd 400 volt wkg. **3/- ea.**
   .1mfd 600 volt wkg. .. **1/- ea.**
   3x .1mfd 600 volt wkg. **3/3 ea.**
   .02mfd 750 volt DC Mica **2/9 ea.**
   .004mfd 1500 V DC Mica **1/3 ea.**
   50mmfd Mica .. .. .. **1/- ea.**
3. **Dual Wire Wound Pots,** front 10,000 ohms, rear 100,000 ohms with ¼ inch shaft. Few only. Brand new, **7/6 each.**
4. **Indicator Unit,** Type 217. Brand new. Each unit has 1 0-100 micro ammeter with 2½ inch scale, indicator lamp, 3 carbon pots, 1 meg, ½ meg, and 5000 ohms. 1-5 amp 240 volt AC DPDT toggle switch and other parts all in metal box, 6 x 4½ x 2 inches. Few only.
   Price only **£2 each.**
5. **Variable Resistors.** These are wound on porcelain formers 1½ inches diameter and have metal ends. The slider is moved my means of a shaft at one end giving a vernier action. Types available: 7.5 ohms at 4 amps; 60 ohms at 1.5 amps.
   Price only **7/6 each.**
6. **Power Supplies Type 10K/190.** 23 Volts input to genemotor. 13 Volts output from genemotor. 200 Volts output from genemotor. Fully filtered with voltage regulator tube. Few only. **Price £2/5/- each.**
7. **Junction Box Type No. 10UB/6032.** Housed in metal box, 4 x 3½ x 1⅞ inches, each unit has 1 EF50 type loctal 9-pin socket, 1 phone jack, 2 co-axial connectors, 1 4-pin miniature socket and several condensers, resistors, chokes, etc.
   **Our price only 4/6 each.**
8. **Type 10PB/7/6 Filter Unit,** consisting of 2 paper condensers and 1 ironcored LT. RF. filter choke on bakelite base, very small. **Only 1/- each.**
9. **2-pin sockets.** ⅜ inch between pins, suit 1-8 inch pins, **3d each.**

## SPECIALS

10. **Heavy Duty Screw Tereminals.** Nickel-plated on Brass. Excellent quality. Worth 4/6.
    **Only 1/6 each.**
11. **3-Bank Wafer Switches. 1/- ea.**
12. **3 - Pole 3 - Position Wafer Switches** with SPDT, AC. toggle switch attached. Worth 10/6.
    **Our price 4/6.**
13. **Magnetic Relays,** type 871, 4-pole, 2-position switch, coil resistance 500 ohms. Brand new.
    **Our price 9/6.**
14. **Magnetic Relays,** type 872, 2-pole, 2-position switch, coil resistance, 40,000 ohms. Brand new. **Our price 15/-.**
15. **Co-axial Connectors.** Pairs of chassis mount female, and angle type male connectors, all screw fittings, Polystyrene insulation. Brand new; a bargain at **4/6 pr.**
16. **New Transformers,** few only. 250 volts, 50 cycle primary; 5 Volts, 2 amp secondary; 10 Volts, 3 amp secondary. Ideal for 6 and 12 volts battery charger, etc.
    **Price only 12/6 each.**
17. **Cathode Ray Filament Transformer.** Few only primary 240 volts, 50 cycle secondary, 2.5 volts at 2 amps with high voltage insulation.
    **Price only 12/6 each.**
18. **Cathode Ray Transformers.** Few only. Primary 240 volts, 50 cycle secondaries, 2—2.5 volt at 2 amp high insulation filaments, with 1—1800 volts, 7.5 ma high tension winding.
    **Price only £2/10/- each.**
19. **Filament Transformers.** Few only. Primary 240 volts at 50 cycles secondaries, 3—6.3 volt at 3 amp.
    **Price only 19/6 each.**
20. **Filament Transformers.** A few only. Primary 240 volts at 50 cycles; secondaries 3—6.3 at 2 amp, 1—5 volt at 4 amp.
    **Price only 19/6 each .**
21. **Power Transformers.** Few only. Primary 240 volts at 50 cycles; secondaries 5 volt at 2 amps and 425 volts aside at 100 ma.
    **Price only 39/6 each.**
22. **Power Transformers.** Few only. Primary 240 volts at 50 cycles; secondaries 5 volts at 2 amps and 425 volts aside at 175 ma.
    **Price only 59/6 each.**
23. **Power Transformers.** Few only. Primary 240 volts at 50 cycles; secondaries 2—10 volts at 10 amps.
    **Price only 25/- each.**
24. **Cathode Ray Filament Transformers.** Few only. Primary 240 volts at 50 cycles; secondaries 2—2.5 volts at 2 amps with over 5000 volt insulation.
    **Price 25/-.**
25. **Filament Transformers.** Primary 240 volts at 50 cycles; secondaries 2—6.7 volts at amps, 1—6.3 volts at 4 amps.
    **Price only 19/6.**

## SPECIALS

26. **Heavy Duty Wire Wound Resistors,** brand new and excellent quality, many made for the British Navy, made by IRC Kriesler and other makers.

| Resistance in Ohms | Wattage | Price |
|---|---|---|
| 9.5 plus 9.5 | 100 | 6/ |
| 36 | 100 | 6/ |
| 45 | 100 | 6/ |
| 50 | 10 | 2/ |
| 50 | 20 | 2/ |
| 30 plus 30 | 60 | 4/ |
| 100 | 40 | 3/ |
| 120 | 80 | 5/ |
| 150 | 20 | 2/ |
| 175 | 25 | 2/ |
| 250 | 20 | 2/ |
| 300 | 85 | 5/ |
| 350 with variable tap | 25 | 2/ |
| 430 | 200 | 8/ |
| 500 | 100 | 6/ |
| 700 | 20 | 2/ |
| 850 | 20 | 2/ |
| 500 plus 500 | 150 | 7/ |
| 2000 | 150 | 7/ |
| 2500 | 10 | 2/- |
| 2500 | 20 | 2/- |
| 2500 | 85 | 5/- |
| 3750 | 30 | 3/ |
| 4000 | 20 | 2/- |
| 5000 | 27 | 2/ |
| 5000 | 40 | 4/- |
| 5500 | 12 | 2/- |
| 7000 plus 300 | 60 | 4/- |
| 25,000 | 30 | 4/- |
| 50,000 | 150 | 7/6 |
| 75,000 | 150 | 7/6 |

27. **Potentiometers.** Standard type pots. All new and guaranteed at reduced prices.

| Resistance in Ohms | Type | Price |
|---|---|---|
| 3000 | Wire wound long shaft | 3/6 |
| 20,000 | Wire wound 1in shaft | 3/- |
| 25,000 | Wire wound long shaft | 3/9 |
| 25,000 | Carbon Short shaft .. | 1/- |
| 50,000 | Carbon 1in shaft .. | 1/6 |
| 200,000 | Carbon Short shaft .. | 1/- |
| 250,000 | Carbon Long shaft .. | 1/9 |
| 250,000 | Midget Carbon medium shaft .. .. | 1/9 |
| 500,000 | Carbon Short shaft .. | 1/6 |
| 1 meg. | Carbon Short shaft .. | 1/6 |
| 2 meg. | Carbon 1in shaft .. .. | 1/6 |
| 2 meg. | Carbon Long shaft .. | 1/9 |
| 3 meg. | Carbon Medium shaft.. | 1/9 |

28. **Extra Special.** ½ meg midget English Carbon Pots, with double pole, double throw switch, long shaft, all new, boxed and perfect. Worth 14/7.
    **Our price 8/6.**
29. Bargains in Midget Variable Condensers, well-known make, polystyrene insulation.

| Plates. | Capacity mmfd. | Price. |
|---|---|---|
| 2 | 10 | 3/6 |
| 3 | 15 | 3/9 |
| 4 | 25 | 4/- |
| 9 | 70 | 5/- |

## SPECIAL NOTICE

**All parcels sent registered post unless otherwise stated. Postage or freight must be included with order.**

547 ELIZABETH ST., MELBOURNE ALSO AT — ALBURY ARARAT BAIRNSDALE BALLARAT
BENALLA BENDIGO BROKEN HILL COLAC DANDENONG ECHUCA SALE FRANKSTON
GEELONG MILDURA SHEPPARTON ST. ARNAUD WAGGA WANGARATTA WARRAGUL

# GEMS ARE LOVELY AND USEFUL

(Continued from Page 19)

ial papers. These papers are ed in such a way that, although look like headache powders, they a groove at the bottom into ch the diamonds fall, thus pre- ting them falling out when the er is opened. It is interesting ote that the use of these papers ractically universal and diamonds transported all over the world hem.

## CKING

When the diamonds are sent away packets of diamond papers are un wrapped in blue, heavyweight en paper.

t is estimated that 23 tons of le ground must be treated in order produce 4½ carats of diamonds, ial to about one-thirty-fifth of an nce. Of this, 4½ carats, 2½ will be only for industrial uses. This ve two carats, of which one carat ll be of inferior stones, and one first quality. Of this one carat lf will be lost in the cutting and inding. Thus for a finished dia- ond of half a carat weight, 23 ns of blue ground has to be mined a weight of 207,000,000 times the eight of the finished diamond.

It will thus be seen that the ssibilities of a racket having any eat bearing on the cost of the ished diamond is rather remote. here are no doubt high profits made times as there are in everything an has ever made. There is also igh taxation. At the outset the outh African Government exacts n export tax of ten pc on the iamond mines. Diamonds are valu- ble almost solely for their beauty, urability and the work entailed in eir production.

With fortunes at stake, attempts re made from time to time to foist mitation stones on to the public. hus, the art of distinguishing the rue from the false is important.

## TESTING

Destructive tests as applied to nany minerals cannot with safety be applied to jewellery. For in- stance a file will scratch any gem stone up to a hardness of Mohs 6½, but it will not scratch a dia- mond, ruby, sapphire, &c. But one can hardly run around with a file scratching relatives' diamond rings to see if they are fair dinkum.

Although you may find out it wasn't a diamond, it might still not be a piece of glass although scratch- able. What do you do after filing a notch in the stone in grandma's bracelet?

If a gem is held on the tongue or cheek it will remain cold for some time whereas glass will become warm quickly

Water will spread on glass while it tends to form into drops on genu- ine stones.

A fairly exact method of identi- fication is by the specific gravity. Tables have been prepared show- ing the specific gravity of various gem-stones. For instance, the specific gravity of a diamond is 3.5, which means that a cubic inch of diamond weighs three and a half times as much as a cubic inch of water. These tables have been prepared for vari- ous gem stones.

X-ray and spectrographic photo- graphs and various microscopic examinations have made the identi- fication of stones quite positive and conclusive so that an imitator needs to be very clever to get away with anything worth while.

A common source of confusion is the calling of gems by some name which resembles the genuine article. Thus, cheap red stones may be call- ed American Ruby, Cape Ruby, Ari- zona Ruby and so on. Ordinary rose quartz has been sold as Bo- hemian Ruby.

Then there are the Cornish Dia- monds, Rhinestones, Scotch Topazes, and so on, which are nothing more than transparent varieties of quartz.

Tourmalines are sometimes sold as Brazilian sapphires, Brazilian emer- alds, Siberian rubies, and so on.

There is no doubt that the red garnet, topaz and some quartz stones are quite good jewellery. But one must be careful of the names by which they are known.



**BEAR HANDY TAPE HAS LIMITLESS USES**

From attic to basement, from front porch to back door, you'll find countless uses for "BEAR" brand HANDY TAPE. Any professional painter or car- penter will tell you what a blessing it is to any handy man or woman.

Made by BEHR-MANNING (AUST.) PTY. LTD., LIDCOMBE, N.S.W.
*Also Manufacturers of Bear Transparent Tape, High Quality Sandpapers and "Proofkote"*

O16C

Specify Microcap better in 6 important ways


1 The AEE "Microcap" incorporates the modern technique of metallised paper in place of conventional alternative layers of paper and metal foil thus producing light weight ultra-miniature, space saving capacitors.

2 The Self-Healing feature is a very valuable characteristic which enables the "Microcap" capacitor to sustain accidental over voltage and provides an additional safety factor.

3 In the "Microcap" capacitor the wire pigtail leads are soldered directly to the capacitor unit in a manner that renders them free from intermittent contact, and the strength of the joint exceeds the tensile strength of the lead.

4 An insulation resistance exceeding 20,000 meghoms for all values at working voltage of 20°C, is obtained on "Microcap" Type W99.

5 They have a power factor better than 1% at 1000 C/S at 20° C.

6 The "Microcap W99 with all the BIG Features mentioned above offers stable long life in MINIATURE form and is available in a wide range of Capacitance and voltages.

MI

Microcap

METALLISED PAPER CAPACITORS

Write or call for leaflets giving further technical details of "Mirocap" W99 Metallised paper capacitors.

*Manufactured in Australia under licence from A. H. Hunt (Capacitors) Ltd., England*

AUSTRALASIAN ENGINEERING EQUIPMENT

CO. PTY. LTD.

476 LATROBE STREET, MELBOURNE. FJ4161




# ONLY THE BEST IS GOOD ENOUGH

(Continued from Page 111)

In the design of small studios, a against large halls where the re cording engineer must often mak the best of it, research into acousti has made vast strides in the last fe years. The results are largely respon sible for the amazingly good record we often hear of small groups of a kinds.

This rather sketchy story of wh recent records are better leads m back to the opening theme, that to day only the best is good enough.

This applies particularly to Aus tralia where, in the early days o LP's, every factory, large and smal was battling against time and man difficulties to make good records.

The public, and the record re viewers too, were most considerat of these early efforts. I know I hav often swallowed an impulse to b most outspoken about releases thought below par, but preferred no to mention them at all rather tha discourage or damage someone wh was trying hard.

But today the competition is get ting really tough. We know that it i possible for a recording company t produce good music, well performed and to impress it on discs which ar competently handled acoustically free from distortion of any kind virtually free from surface noise, and physically perfect.

## LOW NOISE ESSENTIAL

We should no longer be asked t buy records which have a high back ground noise, either in the form o a steady hiss, an intermittent swish a sprinkling of crackles, or damaged surfaces.

And such things as warped discs and "swingers" should be unheard o in the record shops.

We can expect, too, to rule out discs which have a noticeable hum level, or speed variations, or capstan wow.

All these faults are to be found on discs on sale at the moment, although the improvement which has taken place in the last few months is most encouraging, even from the smaller factories who are by no means the only offenders.

In all fairness, the record companies know the truth of what I am saying, and are sparing no effort to keep their products to a high level. It is in their own interests to do so, for unless faulty records are ruthlessly rejected, either before or after pressing, not only will the label concerned suffer loss of reputation, but an unnecessary sales resistance to records generally will be built up in the public mind.

There was a time when the best LP's were those imported from overseas — so much so that many serious collectors would not buy locally made discs.

That position no longer holds. The best of the local pressings I have heard during the last few months, including many different labels, are quite equal to the best I have heard from abroad.

The competition is certain to become keener than ever from now on, and unless quality is maintained, those responsible, no matter who they are, will suffer in sales and reputation.

# FROM THE SERVICEMAN WHO TELLS

(Continued from Page 43.)

ny apparent anomalies will be lained.

Finally, I must comment on a er in which the writer takes me task concerning my solution to problem which I detailed in the ril issue. Readers may remem- that this concerned a set which a four-volt power transformer ing vainly to energise a set of volt valves. As a simple method maintaining oscillator activity I dified the padder circuit to pro- e feedback and, on the owner's tructions, left it at that.

Commenting on this Mr. J.C.L., Canberra, ACT, writes as follows:

*'In your April issue I happened read your feature "The Service- n Who Tells" and in this article ur serviceman has been caught th a 4 volt power transformer in set equipped with 6 volt valves. ow in this sort of trouble a new lve will work every time but not r long. The mixer will operate ith more than normal hiss and the t will warm up slowly.*

*"There is only one cure for this ouble and that is to use an auto- ansformer such as the TP80 which advertised on page 50 of the same sue of your magazine.*

*"Ordinarily I find your articles ery informative but in this case I m deeply shocked at the state your rviceman has gotten into and I dvise a long sea voyage."*

Regarding most of Mr. J.C.L's. etter I must say I couldn't agree nore. In fact, I mentioned at the ime that I was far from happy with he solution and that I would have nuch preferred to do the job pro- erly. Unfortunately, the serviceman loes not always have the final say n these matters, the owner often aving very definite ideas about how nuch he wants to spend on the job.

Such was the case with this set. (As I also mentioned in the original article.) The set was an old one, the owner wanted the cheapest possible job. I explained the position to him, compared the costs, and he made the decision. There was little more that I could do.

Whether I had fitted a completely new transformer or an auto transformer would not have made very much difference on the score of cost. Admittedly the auto transformer is cheaper (though not cheap) but it would have involved a lot of mechanical work to fit it, thus largely offsetting this advantage.

In addition there is the problem of obtaining an auto transformer these days. Designed as an emergency unit during the war they are no longer plentiful.

There is also the question of the power rating for these devices. Originally designed to solve the valve replacement problem during wartime they were intended to supply two or three valves at the most. The set involved was a large one, having six valves apart from the rectifier and the total power to supply these worked out at nearly 17 watts. The maximum rating for the TP80 is 10 watts.

As for the long sea voyage; well, that would be very nice, too—except that I can't afford it. Of course, if Mr. J.C.L. would like to organise "A Fund For Sending The Serviceman Who Tells On A Long Sea Voyage" I feel sure that I could fix my part of the arrangement.

Meantime, I'd better get back to the bench and earn some money for the more commonplace necessities of life.

## FM PICKUP FOR ELECTRONIC ORGAN

(Continued from Page 63)

isolation and preserve the Q of the main filters.

The signals, which are split up in the main filters, according to pitch, are mixed again in the register switch. A swell control is inserted just before the output.

The tremolo registers are connected in after the swell control, and ganged with it, so that the relation Signal-Tremolo remains always the same according to the setting of the tremolo level setting.

A relay with one changeover, one make and two break contacts controls the circuits associated with the tremolo register, although this is not immediately obvious from the block diagram.

Jacks K1 and K2 can be used for the addition of other effects generated externally.

Amplifier V5 is not actually an amplifier, but serves to mix the signal from the tremolo oscillator to the actual signal.

With the register Tutti in operation the register filters are bypassed through the contact TI III., applying the full voltage from the main filters to the output mixing amplifier V5. In this position it is possible to remove the tremolo altogether.

There still remains the problem of registers. To avoid any handcapacity effects, these operate in a section of comparatively high signal level, which also helps in maintaining a high signal-to-noise ratio. In addition the register controls will not have to be shielded, an important consideration, which makes the construction less involved.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| 1R5 | 15/0 | 2050 | 15/0 |
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| 6SN7 | 10/6 | 9004 | 7/6 |
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| 6AG7 | 10/6 | 7C5 | 7/6 |
| 6AC7 | 10/6 | EF50 | 10/6 |
| 6AG5 | 12/6 | 12SR7 | 2/6 |
| 6J7G | 10/6 | 1K5 | 2/6 |
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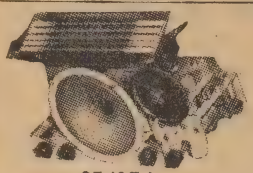

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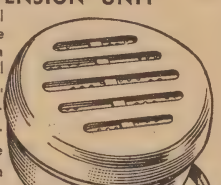

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# ANSWERS TO CORRESPONDENTS

(Burwood, Vic.) asks our advice vercoming electrical interference on ddystone 640 receiver.

If the interference is coming through ower mains, we would suggest that try a mains filter unit as described & H for Jan., 1953, if it is not icable to suppress interference at ource. If it is being picked up in aerial, possibly the twin doublet l described in Nov., 1948, or the anti- aerial system described in July, would be of assistance. Copies of circuits of these units and brief ls are available through our reader y service and some copies of R & H, 1953, are still available from this e.

S.C. (Kalgoorlie, WA) asks us to let have circuit details of a DC milli- meter that he requires for some geo- sical research work.

We are afraid that we cannot st you in this instance as the re- ement is rather specialised. If your stigation appears to merit further in- igation it may be possible to obtain stance from a technical college. We it that you have seen the article he September, 1954, issue, which may you some ideas to work on.

H.S. (St. Ives, NSW) forwards to us ircuit of a supply for operating an tric shaver from a car battery and s our advice.

We did describe an inverter supply he April, 1951, edition of R & H. This t was designed for the operation of a ntel receiver from a car battery and was pointed out in the article that vibrator would need to be of the 50 les type if it was to be used for an tric shaver or other equipment which s frequency dependent. Copies of the cuit and photos are available from query service.

R.E.H. (Wollongong, NSW) inquires ut circuits for the radio control of del aircraft.

: Yes, R.E.H., we did print a series of icles on the radio control of model craft in the September, 1950, issue of & H but unfortunately this copy is no nger available; neither are copies of article available through the query rvice. However, you may possibly be le to borrow a copy or obtain photo- ts from the public library.

J.M. (Leichhardt, NSW) asks for the formulae for the smoothing circuit of a voltage doubler supply.

A: The formulae for any smoothing circuit is not dependent upon the type of supply feeding it but upon the frequency of the ripple voltage. For detailed information on this subject we would suggest that you refer to the Radio Designer's Handbook, Fourth Edition, Chapters 30 and 31.

J.P. (Wayville, SA) says he enjoys reading R. TV. & H. but would like to see us describe a modern version of "Tom Thumb", especially for the use of young experimenters and hikers.

A: Thanks for your remarks, J.P., and for your suggestion. We will certainly have another look at the "Tom Thumb" circuit and see what ideas we can get.

D.B. (Coogee, NSW) would like to see us publish articles on the modification of British television receivers for Australian standards.

A: We have had similar requests from readers who have also wanted to import and modify American receivers. There can be a lot more to it than a "few simple alterations". Furthermore, there is such a diversity of circuit arrangements that each receiver would have to be treated on its own merits. Don't forget that Australian standards envisage the use of negative modulation, FM sound and UHF channels, which don't appear on English receivers. We suggest that you "hold your horses" for a while.

F.J.C. (Parramatta, NSW) writes to the serviceman to suggest that he assist the general public in their choice of radios by making a regular technical review of current commercial receivers. He also makes some caustic comments about the quality of commercial sets in general and suggests there is room for considerable improvement.

A: Many thanks for your letter and comments, F.J.C., and we will pass your letter on to the serviceman for his possible comments. However it must be realised that servicing of sets is only one angle of set design and production and that various conflicting requirements have also to be met. Nevertheless, we agree that the workmanship in some cases leaves much to be desired, though these are often isolated cases.

G.L.S. (Adelaide, SA) would like to know why the plates of the No. 10 valves in his Tesla coil heat up to red heat. He would also like to know the ratings of the 15E valve.

A.: We are not familiar with the Tesla coil in question, so that any advice we can give would be necessarily of a general nature. The heating of the plate indicates that the plate dissipation rating of the valves is being exceeded. This could be due to a number of reasons. Grid bias and/or plate voltage may not be right. It would also be possible that the loading presented to the plate circuit by the coil is excessive. More than that we cannot say, and we suggest that you check along these lines.

The 15E valve is a class C RF power output and oscillator with a 6.3V 3A filament. Maximum ratings are as follows: Plate volts 2000, plate current 53 mA, grid current 18 mA, grid bias minus 130 volts. The maximum power output would be 100 watts.

G.C.F. (Caloundra, Q.) asks about cable impedance for television and the use and replacement of tapped volume controls.

A.: The measurement of a cable impedance is a laboratory measurement and would not normally be carried out except during manufacture. The cable impedance is stated by the manufacturer and could be determined from them. In general, the coaxial types range from 50 ohm to 120 ohm and the flat parallel wire types range from 150 ohm for the close spaced types to 300 ohm for the more widely spaced. Open type wire lines from 300 to 600 ohms. The piece of twin flex which you say a friend called a 500-ohm line was not so. What was probably meant was that the source impedance and the load to which line was connected had an impedance of 500 ohms. In an application like this, any piece of wire would be satisfactory, the question of characteristic impedance only arising in RF service. Tapped volume controls are normally used to obtain some form of tone control balance at low audio volume levels where the characteristics of the ear change from those at higher levels. They may also be used for negative feedback purposes. In general, tapped controls would need to be replaced with identical units, although this may be less important with some circuits than others.

R.J.B. (Perth, WA) writes in appreciation of the 1955 Babygram which he has found to be a first-class performer. He goes on to suggest that we describe a two-valve (plus rectifier) superhet as a logical sequel to it and mentions a design published elsewhere.

A.: Many thanks for your report on the Babygram, R.J.B., and we are glad to learn that you have had so much success with it. A superheterodyne along the lines you mention was described in Radio and Hobbies for May and June, 1952. This employed a 6AN7 and ECC33 in one version and a 6AN7 and 6AB8 in the other. Copies of the circuit are available through our query service.

C.C.M. (Temora, NSW) has a pre-war vibrator set which uses an indirectly heated output valve (type 6G6) and the conventional directly heated, two-volt valves in other positions. He wants to convert it to AC and wants to know what valves to substitute for the two-volt series.

A.: We suggest the 6J8 for the 1C7, a 6U7 for the 1D5, and a 6B8 for the 1F7. More modern valves could be used but the smaller sockets would undoubtedly cause mechanical problems, while the higher gain might prove a problem in so old a circuit. Since the HT current and voltage requirements of the output valve are quite low, a small power transformer of about 150 volts, 30 mA, would probably suffice. Either a 6X4 or 6X5 rectifier would be suitable but the available space may make the smaller 6X4 preferable.

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Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cut-outs in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

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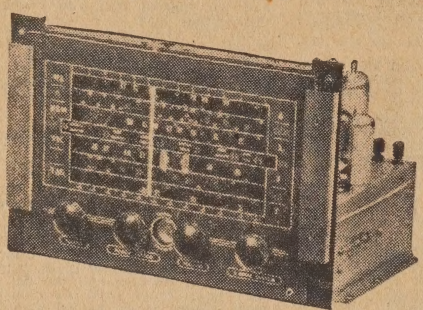

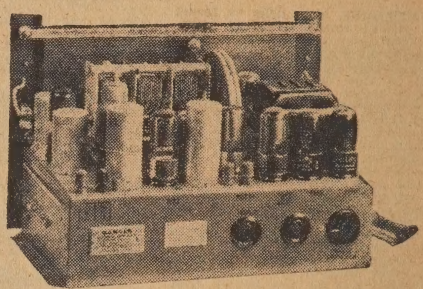

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- Speakers supplied are Magnavox 12in and 8in permanent magnet with tropic proof transformer.
- Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations in each State in prominent type, fitted with counterweight drive and indicator lights on dial showing which band in operation.
- Dial can be supplied in cream or brown with matching knobs and escutcheon to suit blond or walnut cabinets.

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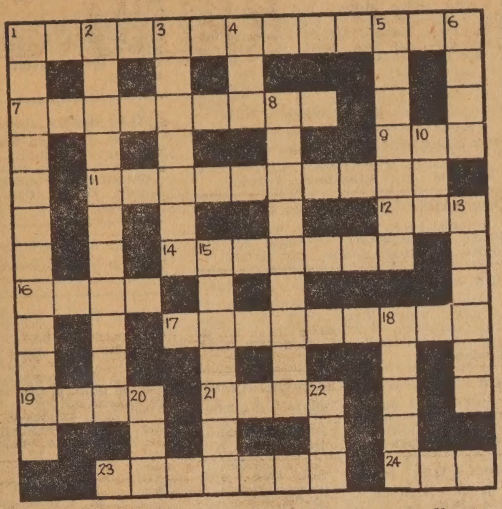
# THE R. & H. CROSSWORD No. 15



**ACROSS**

1. Variable divider. "X" component of impedance. Used in threading holes.
2. Valve element (2 words)
3. Pounds, shillings, pence (abbrev.).
4. Permit.
5. Part of the eye.
6. Feature article.
7. Outer surface of a wheel.
8. Part of a transformer.
9. Connection between sections of an aircraft frame.
10. Soldering end of an iron.

**DOWN**

1. Dielectric constant.
2. Compact communication equipment.
3. Pertaining to nature.
4. Charged atom.
5. Woven fabric.
6. Type of file.
8. Stage in a receiver.
13. Two-fold.
15. Electrically produced.
18. Incoming signal.
20. Pertaining to the self.
22. Unit of work.

***Solution and further crossward next month***

## Last Month's Solution

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | T | Z | E | N | D | R | A | H | T | | | | |
| E | | R | | O | | I | | A | | D | | | | |
| C | H | A | S | S | I | S | | R | E | L | A | Y | | |
| H | | N | | | S | P | | K | | N | | | | |
| E | | S | E | L | E | N | I | U | M | | A | | | |
| R | I | M | | | | P | | O | | T | | | | |
| W | | I | N | P | U | T | | O | R | D | E | R | | |
| I | | S | | U | | R | | S | | O | | | | |
| R | E | S | I | S | T | A | N | C | E | S | | N | | |
| E | | I | | H | | C | | | C | | | | | |
| S | P | O | T | | T | E | T | R | O | D | E | S | | |
| | I | N | N | E | R | | O | D | | O | | | | |
| | N | | T | Y | | T | H | E | R | M | S | | | |

**P.C.L. (Canberra, ACT)** writes to the serviceman to point out that the correct solution to his problem of the April issue was to have used an auto-transformer.

A: Many thanks for your letter and comments, J.C.L., and we will pass your letter to the serviceman. We feel sure that he will be able to give a satisfactory explanation as to why he did not choose this solution to the problem. In the meantime we can only comment that it is fairly obvious from the article that the matter of cost was most important.

**F.P. (North Geelong)** says he enjoyed reading the articles by R. A. B., Tarrant on electric organs. He would like to see further articles on the same subject.

A: Many thanks for your letter, which was one of several expressing similar sentiments. We will keep a look out for anything further that may be of interest to you.

**R.H.B. (Melbourne, Vic.)** sends in a year's subscription.

A: Many thanks for your letter and kind remarks concerning the magazine, R.H.B. It is gratifying to hear that the magazine has held your interest these many years. We have passed on your subscription to the appropriate department and trust that you are now in receipt of same.

**R.C. (Wellington, NZ)** forwards the balance of a fee for circuits, &c., and suggests that we describe the construction of a simple electric organ which could be used with a standard amplifier.

A.: Many thanks for your letter, R.C., also the fee. We are glad to hear that you find the magazine so interesting and we hope it will continue to prove so helpful. We are also grateful for your suggestion regarding the organ and we will keep the idea in mind. At the moment we are not sure whether such a scheme would be feasible, but the current series of articles on electronic music may result in a wider interest in the subject and the development of something along the lines you suggest.

# Let's buy an argument

**Continued from Page 101**

original amplitude are being fed into the amplifier, while the response at extreme frequencies is being accentuated by something approaching positive feedback.

The result is inevitable. Excited by transient components in the heavy input signal, the amplifier tends to produce damped wave trains at the same frequency as the peak in its response curve. In other words, it "rings".

It is next to impossible to separate these ringing components with ordinary program material, so we adopt the alternative of testing with square-wave input. The sharp front of each wave shocks the amplifier into oscillation, the oscillatory pattern being superimposed on the flat top.

By synchronising the CRO time base with the input wave, the patterns remains stationary for all to see.

The square-wave test is an exacting one, to be sure, and possibly more searching than it strictly need be for most applications. All the same, it's nice to know that your amplifier doesn't "ring" and therefore cannot introduce components into the output which might have a degrading effect.

*Talc is a granular mineral with a shining lustre. It can be separated into sheets, and is either transparent or translucent. It is often used instead of window glass by the Chinese.*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**FOR SALE:** All back issues R & H at 4/- per copy, incl. post. **T. Weir, 73 Gibson Av., Padstow.** Prompt service. Inquiries **UY8056**, Sydney, or letter.

**FOR SALE:** New Still Cartoned Radio Valves, Type CV92 (Micro-pup), £1 per pair. Valve Type 6SF7, 5/- each. Large numbers. Postage extra. **K. B. Flynn, 28 Clydesdale St., Box Hill, E.10, Victoria.**

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**FOR SALE:** Philips Sig. Gen., £25, excel. National U.H.F. Receiver, £10. Valves, 6J6, 6AG5, 7/6 ea. Other radio parts cheap. **170 Dunning Av., Rosebery.**

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**SELL:** Technicorda Tape Recorder. **J. Vercoe, Tyndale, Clarence River**

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**SELL:** Radio & Hobbies complete issue, Vol. I, No. 1 to May, '55. Offers to **A. B. Young, Haylock St., Wynnum, Qld.**

**SELL:** AR7 with coils, power sup speaker, £45. Commando Rece MCR1 with AC power-pack, phones, £10. 3—110 K/C I.F.T.; 110 and 1600 BFO coils, 8/- each. 12 OX, £7. **D. Carr, 523 Nearim Rd., Unrrumbe UM1894.**

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